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THE WILSON BULLETIN

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THE WILSON BULLETIN

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THE PRESIDENT'S PAGE

The Wilson Ornithological Club is deeply indebted to Dr. Josselyn Van Tyne for his services as Editor of 10 volumes of *The Wilson Bulletin*.

In order to edit this journal, while at the same time carrying on his official routine at the University of Michigan, evenings and holidays were sacrificed and opportunities for original research were curtailed. There was always an endless stream of letters to be answered, manuscripts to be edited, and proofs to be read. In fact, at no time during his 10 years of office was he completely free from the responsibilities which the *Bulletin* entailed.

Edited by him were 40 numbers (No. 1 of Vol. 51 through No. 4 of Vol. 60) with pages totalling 2,847. Altogether they contained 175 papers and 252 general notes representing many aspects of research and observation in ornithology and overlapping fields. Several of the papers proved to be among the most important contributions yet made to biological literature.

In the years of his editorship a number of innovations appeared in the pages of the *Bulletin*. Reviews of all books, monographs, and other publications of similar scope were assigned to persons best qualified to speak critically and constructively. Thus the 168 reviews printed were notable for their usefulness to authors and readers alike. For the convenience of students and research workers, a bibliography (*i.e.*, a list of recent literature of value to ornithologists) was instituted, then later extended and classified according to subject matter. Reprints of this list were made available at cost. Handsome frontispieces became a regular feature; of the 29 published, 8 were in color. A section on conservation, brief biographies and photographs of new life members, and lists of new acquisitions to the Wilson Club Library were additional innovations.

Today the Club has twice as many members as it had 10 years ago. Such a remarkably rapid growth is in no small measure a tribute to the excellence of the *Bulletin*.

Obviously the Club's indebtedness to Dr. Van Tyne cannot be met by words and tokens because his task has been a thankless one. We can only say that we are immensely appreciative of each moment devoted to the pages of the *Bulletin* and that we are extremely proud of the result.

OLIN SEWALL PETTINGILL, JR.

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WILSON CLUB NEWS

RECENT DEATHS

Mrs. Vernon Bailey (Florence Merriam) died September 28, 1948.

Dr. T. C. Stephens, editor of the Wilson Bulletin for many years, died November 24, 1948. An obituary will be printed in a future number.

PERSONALS

Oliver H. Hewitt has been appointed Assistant Professor of Wildlife Management at Cornell. He has been with the Dominion Wildlife Service at Ottawa.

William F. Rapp, Jr. has been appointed editor of the Nebraska Bird Review.

The first award from the Pell fund, established by an anonymous friend of the Wilson Ornithological Club in memory of S. Morris Pell, has been made to Mr. Donald Malick in recognition of his ability and promise as a bird artist.

Dr. Daniel L. Leedy has been put in charge of the national Cooperative Wildlife Unit Program to succeed Dr. Logan J. Bennett who has been made chief of the Research Division of the U. S. Fish and Wildlife Service.

EDITORIAL

Your editor fledges his first issue of the Wilson Bulletin with great solicitude. He hopes that members of the Club will remember that the Bulletin is their journal and that the members will freely express their suggestions for improvement. The Bulletin should continuously evolve and adapt itself to the new desires of its readers. Your editor is fully aware of some deficiencies and expects to be advised of others.

In order to economize on secretarial help your editor will reduce his correspondence to the basic essentials. Therefore please accept his apologies for failing to answer letters promptly or for sending a post card.

ANNUAL MEETING

The thirtieth annual meeting of the Wilson Ornithological Club will be held at Madison, Wisconsin, on April 21–23, 1949, with field trips on the following day, Sunday, April 24. The program will offer an outstanding selection of scientific papers and movies. All sessions will be held in the Theatre of the Wisconsin Memorial Union, located at the corner of Park and Langdon Streets. For accommodations or further information about local arrangements, please write George A. Hall, Registration Chairman, Department of Chemistry, University of Wisconsin.

WEIGHT VARIATIONS IN WINTERING WHITE-THROATED SPARROWS IN RELATION TO TEMPERATURE AND MIGRATION

EUGENE P. ODUM

MANY wild birds in temperate regions undergo seasonal weight variations which presumedly are the result of changes in endocrine balances. Since internal changes may be related to environmental changes or perhaps be the result of an inherent rhythm, knowledge of the seasonal "weight picture" is of both physiological and ecological interest. A regular seasonal rhythm, with an increase in weight in winter and a decrease in weight in summer, has been demonstrated for many species of birds (Nice, 1938; Baldwin and Kendeigh, 1938). It has been suggested that this seasonal cycle is correlated, roughly at least, with temperature, since individual birds usually gain weight during cold weather (provided adequate food is obtained) and lose weight during warm weather (Baldwin and Kendeigh, 1938). It is advantageous to a warm-blooded animal to be heavy at low temperatures (heat loss is decreased) and lighter at high temperatures (heat loss is increased), but of course this does not mean that all birds will necessarily show such an adaptation; changes in feather covering and rate of metabolism, for example, could adapt a bird to seasonal temperature changes without a change in basic weight.

In addition to (or superimposed upon) the winter-summer weight rhythm it would seem logical to suppose that migratory species would show marked weight variations directly related to migration. Despite the fact that collectors have long known that many species become fat (and hence presumedly increase in weight) prior to and during migration, actual weight data demonstrating a migration increase is meager. Since Wolfson (1942, 1945) has recently summarized the literature on the subject, only a brief resume need be given here. Linsdale and Sumner (1934a, 1934b) found that the Golden-crowned Sparrow (*Zonotrichia coronata*) on its California wintering grounds not only gained weight in winter (up to 31 grams in January) but reached an even greater peak just before spring migration (35 gm. in May). Baumgartner (1938) who weighed Tree Sparrows (*Spizella arborea*) both on wintering and breeding grounds found that the highest weights occurred in late February and early March, prior to and during spring migration. Weights were also higher during fall migration than in late summer or early winter. Wolfson (1945) has reported that migratory races of Oregon Junco (several races of *Junco oreganus*) and White-crowned Sparrow (*Zonotrichia leucophrys pugetensis*) are heaviest just prior to spring migration. He also presented preliminary evidence to indicate that fat deposition was largely responsible for the

spring peak in the Junco. In the case of the Tree Sparrow, White-crowned Sparrow, and Junco, which migrate early, the premigration peak follows directly after the winter increase resulting in only one major peak in weight. In the Golden-crowned and Fox Sparrows (*Passerella iliaca* data of Linsdale and Sumner, 1934b), which migrate later, the weight decreases in late winter and early spring before the pre-migration increase occurs resulting in two major weight peaks. Wolfson (1945) further presents a table of winter and spring weights of 7 species of permanent residents which shows that these nonmigratory species decrease in weight in the spring without undergoing fat deposition. The data on non-migratory subspecies of the Oregon Junco (*J. o. pinosus*) and White-crowned Sparrow (*Z. l. nuttalli*) are especially significant since the resident forms, in contrast to migratory forms of same species, do not show a spring weight increase.

In analyzing thousands of weights at all seasons taken over a period of several years at the Baldwin Bird Laboratory at Cleveland, Ohio, Baldwin and Kendeigh (1938) failed to note significant weight variations that might be related to migration. However, it should be noted (as has been pointed out by Wolfson, 1945) that most of the weights discussed in this paper were obtained from permanent resident species or individuals of migratory species during or after migration; few weights were obtained *prior* to migration. Also, as will be discussed later, monthly averages may obscure significant variations if they happen to occur in a short period or come partly during one month and partly during another.

There can be no doubt that fat deposition and weight increase before or during migration is advantageous to a migratory bird since extra energy would be provided for the strenuous journey. However, as in case of a winter-induced weight increase, demonstration of advantage does not prove that all migratory species, subspecies or even both sexes of same species necessarily show the adaptation. Species of various seasonal status living in various climatic regions must be studied to determine the actual situation.

Because the White-throated Sparrow (*Zonotrichia albicollis*) is a late migrant and may be easily trapped and collected on its wintering grounds in southeastern United States, it has proved a favorable species for the study of the relative effects of winter and spring on the weight of a migratory bird. A study of the White-throated Sparrow has been undertaken as a part of a joint project with Albert Wolfson, who is continuing his experimental work on the physiology of migration at Northwestern University. The present paper is concerned with the analysis of data on total body weight. A study of weights of body parts and the exact determination of the amount and distribution of body lipids in collected birds is now being made as a joint research with Jesse D. Perkinson, biochemist at the University of Georgia, with the aid of a grant administered jointly by the University and the Carnegie Foundation.

Materials and Methods

For two successive seasons, 1946–47 and 1947–48, weights of White-throated Sparrows were obtained during the seven-months wintering period (mid-October to mid-May) of the species at Athens, Georgia. Of the total of 247 weights (142 males, 105 females) available for analysis, 116 were obtained from collected specimens shot in the late afternoon and weighed within an average of an hour after death. The remaining weights were obtained from 85 individual birds captured and banded on the University campus. Three funnel traps were used which were set near the Biology Building where they could be closely watched and birds removed soon after capture. Weights of repeat and return birds were treated as individual weights provided at least three days had elapsed since the last capture. In order to minimize the daily rhythm factor which is so prominent in small birds (*see* Baldwin and Kendeigh, 1938) and to make weights of banded birds comparable with those of collected birds (which were always taken in afternoon) weights of birds taken in traps before 10:00 A.M. were eliminated from the final data. Our experience has been that at about midday birds recover weight lost during the preceding night. Therefore, weights analyzed in this paper may be considered close to the daily maximum weights. A little over half (133) of the total weights were obtained during the first season (1946–1947). All birds, both collected and trapped, were weighed on the same Ohaus double-beam balance accurate to 0.1 gram. Live birds were placed in a small aluminum box counterbalanced on the scale before each weighing.

The sex of collected specimens was determined positively by internal dissection. For banded birds wing measurements proved to be the most reliable, although by no means infallible, basis for sexing. Wing measurements (the chord measurement without flattening normal curvature) of 116 birds of definitely known sex (collected specimens) were distributed as shown in Table 1. On the basis of these data, banded birds with wings of 74 mm. and over were recorded as males, those with wings of 69 mm. or less, females. Birds of intermediate size were recorded as either males or females according to wing measurement and plumage characters, females having a more brownish cast to nape, head and back. By the second season of work our experience was such that we very rarely were wrong when we predicted the sex of a collected bird before dissection. Undoubtedly, however, errors were made in sexing banded birds, especially intermediate-sized birds, but I do not believe that such errors affect the validity of the trends in weight being analyzed.

We are not sure that we have discovered reliable criteria for age determination and have not attempted to break down the total data into adults and immatures (first-winter birds), although some of the collected birds could be aged with certainty. The possible significance of age is discussed later.

Grateful acknowledgement is made to David W. Johnston, who was largely

responsible for operating banding traps and collecting birds in 1946–47 and to James C. Major who performed the same duties in 1947–48. Robert A. Norris also aided in collection of specimens, especially in the important month of April. Without the diligence of these students in the field it would have been impossible to fit this type of research into a busy academic schedule.

Results

The total data (247 weights) for the two seasons are averaged by months and half-months in Table 2, and plotted by half-months in Figure 1. In effect, the histogram in Figure 1 gives, at a glance, the average "weight picture" of the White-throated Sparrow on its north-Georgia wintering grounds. In

TABLE 1

Wing Measurements of White-throated Sparrows of Known Sex

WING MEASUREMENT IN MM.	NUMBER MALES	NUMBER FEMALES
65	0	2
66	0	1
67	0	9
68	1	12
69	1	18
70	1	8
71	3	4
72	5	4
73	9	4
74	10	1
75	10	1
76	9	0
77	1	0
78	1	0
79	1	0
Total	52	64

Figure 2, data for the first season only (1946–47) are plotted for short intervals together with the average daily air temperatures for the same periods. In Figure 3, 97 weights (for both years) in the critical spring period are plotted individually to give a picture of changes occurring just before northward migration.

Two distinct cycles are evident from the data, a peak in weight being reached in midwinter and another, greater peak in males, being reached in late April just prior to northward migration. Average weights were lowest in October and November shortly after the end of fall migration. The averages for these months (males 26.8; females 25.4) are very close to averages given by Nice (1938) and Baldwin and Kendeigh (1938) for birds trapped during the fall migration in Ohio. From the low point in the autumn, weight gradually increased with a winter peak being reached in early February, males 29.8, females

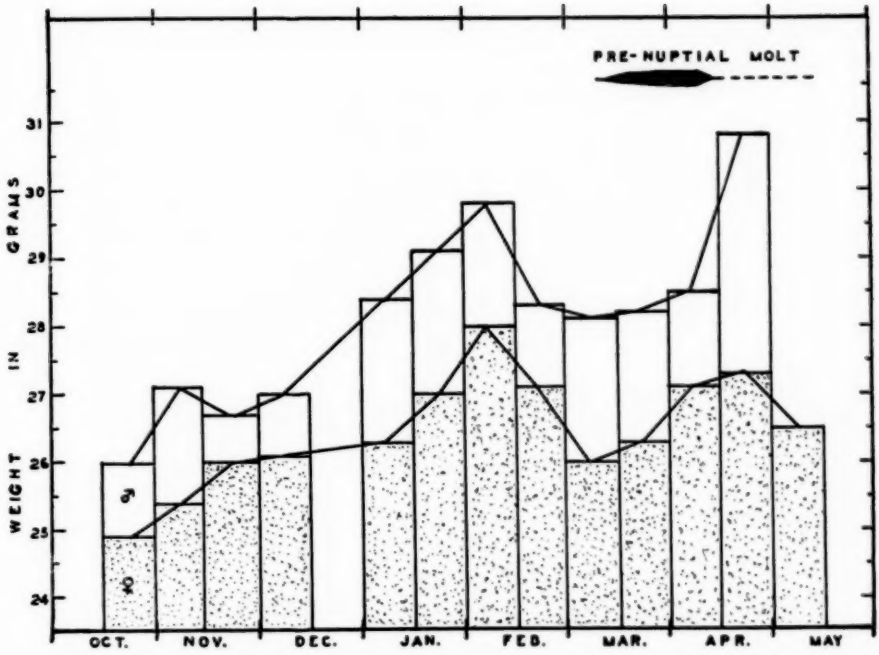

FIG. 1. Histogram of "weight picture" of White-throated Sparrow on its wintering grounds at Athens, Georgia. A summary of two seasons' data (247 weights, see Table 2) with averages plotted for half-month intervals; upper curve male, lower, female.

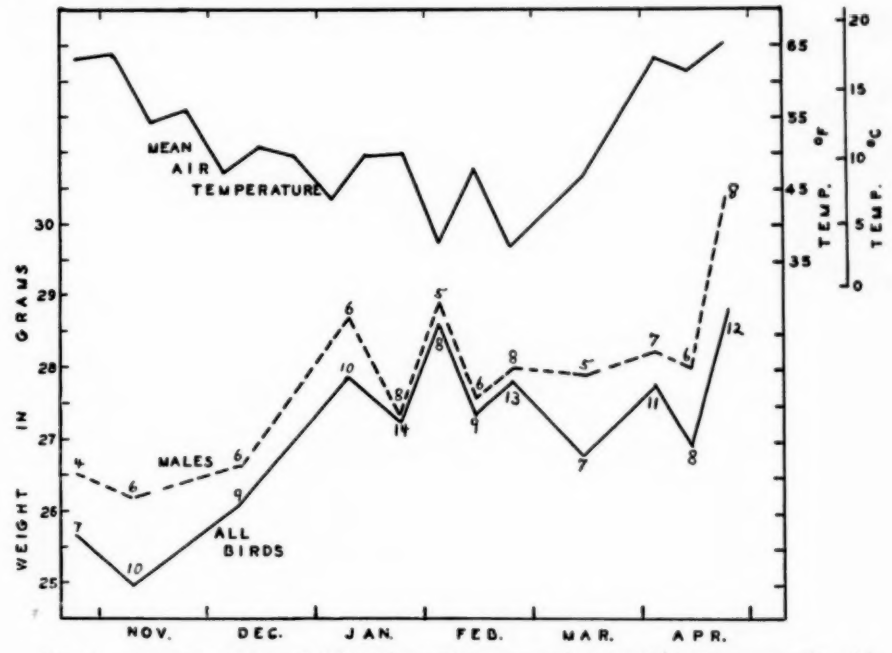

FIG. 2. Average weights of White-throated Sparrows for the 1946-47 season only with means of air temperature recorded for same period by the US Weather Station at Athens, Ga. Figures on the weight curves represent number of individuals on which averages are based.

28.0. As shown in Figure 2, variations in winter weight in 1946–47 are inversely correlated with temperature. Thus, the coldest periods during that year were the first 10 days in January, the first 10 and last 10 days in February; each cold period, especially the first two, coincides with a peak in weight. The same relation to temperature is indicated by 1947–48 data although the weights for this winter are not sufficiently distributed to permit plotting a complete curve. The coldest period in the 1947–48 winter was the last half of

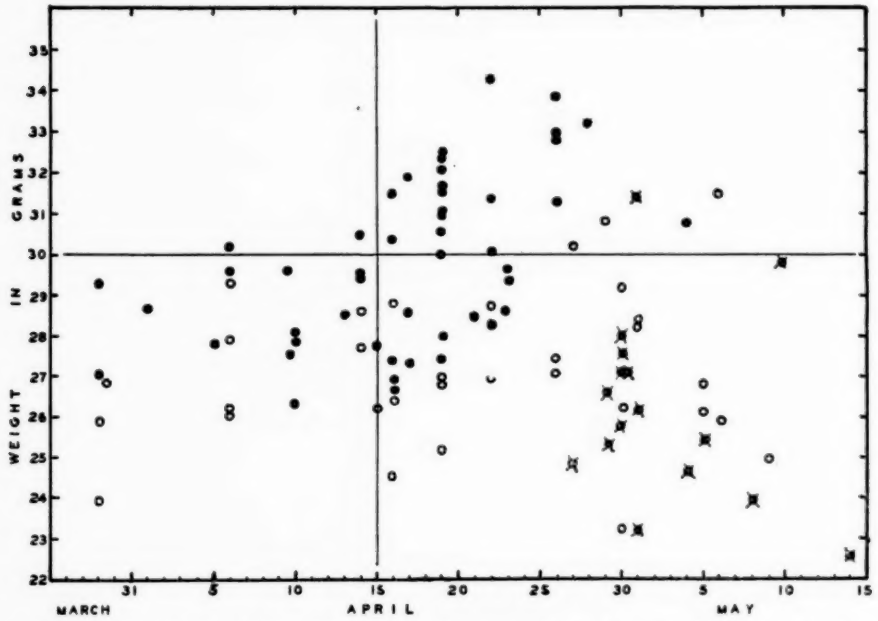

FIG. 3. Distribution of 97 weights from both seasons during the critical late-spring period. Each symbol represents an individual weight record, largely an individual bird since over half the records are from collected birds. Solid circles are males, open circles, females. Dull-plumaged, late-molting females, believed to be first-year birds are indicated by ⊠. Note that after April 15 males increase in weight rapidly and leave the region, while response in females is later and much more variable.

January and first part of February and both average peak weights and peak weights for individuals were recorded during this period.

The stimulating effect of low temperatures in winter is further indicated by the fact that males averaged heavier during the cold period January 1 to February 15, 1948, than during the same but warmer period of 1947 as shown in Table 3. The difference, 1.6 grams, is reasonably significant since it is 2.5 times the standard error of difference (0.62) as determined by use of formula for small samples (Fisher, 1936).

Another difference between the two years seems related to temperature. Early November, 1947, was colder than the same period in 1946; likewise No-

vember 1947 birds were heavier. This produced the "hump" in the curve of males (see Figure 1) since a large proportion of November weights were obtained in 1947.

TABLE 2

Average Weight of White-throats at Athens, Georgia; two season's data combined

PERIOD OF OBSERVATION		MALE		FEMALE	
		No.	Wt. in grams	No.	Wt. in grams
October	Last half	4	26.0	7	24.9
November	First half	8	27.1	5	25.4
	Last half	10	26.7	6	26.0
	Total	18	27.0	11	25.8
December	First half	10	27.0	5	26.1
January	First half	7	28.4	3	26.3
	Last half	16	29.1	8	27.0
	Total	23	28.9	11	26.8
February	First half	13	29.8	10	28.0
	Last half	11	28.3	8	27.1
	Total	24	28.7	18	27.7
March	First half	4	28.1	6	26.0
	Last half	8	28.2	6	26.3
	Total	13	28.1	12	26.2
April	First half	20	28.5	11	27.1
	Last half	26	30.8	19	27.3
	Total	46	29.8	30	27.2
May	First half	*		15	26.5

* Virtually all males migrated north by May 1. One exception (May 4) is included in late April weights.

TABLE 3

Comparison of Winter Weights of Male White-throated Sparrows for Two Seasons

YEAR	AVERAGE TEMP. JAN. 1–FEB. 15	NUMBER MALES	AVERAGE WEIGHT, GRAMS	PER CENT INDIVIDUALS OVER 30 GRAMS
1947	45.2° F	21	28.6 ± 1.36	19
1948	40.6° F	15	30.2 ± 2.02	53
Difference			1.6 0.62	

During the early spring, weights dropped below the winter peak. The prenuptial molt, a partial molt in this species involving feathers of head and body tracts, began the middle of March and continued into April, every individual examined the first half of April being in molt. By April 15 molting was virtually complete in males, which then began a rapid, almost spectacular

increase in weight as shown in all three figures. In Figure 3, for example, it will be noted that during the first half of April only two males out of 17 weighed over 30 grams and none reached 31 grams. Between April 15 and 30, however, 20 out of 31 weights topped 30 grams, and 16 of the 20 exceeded 31 grams. The late April average for males was over 2 grams greater than peak weight for winter of 1946–47 and 1 gram greater than the higher 1947–48 winter peak (see Table 2). By May 1 almost all males had departed from the vicinity of Athens. In 1947, one male was obtained on May 4, while in 1948 no males were collected or trapped after April 25 despite intensive search for them.

Weights of four individual banded males which repeated over long periods are given in grams in Table 4. It will be seen that these individual variations parallel average trends as shown in Figure 1. The first 3 individuals clearly show an increase from fall to winter. Individuals No. 2 and No. 4 demonstrate

TABLE 4

Afternoon Weights (in gms.) of 4 Male White-throated Sparrows (1946–47)

NO. 1		NO. 2		NO. 3		NO. 4	
Date	Wt.	Date	Wt.	Date	Wt.	Date	Wt.
Nov. 6	26.4	Nov. 15	27.9	Nov. 8	25.4	Jan. 18	30.0
Jan. 28	27.4	Jan. 23	27.4	Feb. 12	29.2	Feb. 27	29.4
Feb. 4	30.1	Feb. 4	30.9	Feb. 28	26.3	Apr. 9	29.6
Feb. 11	28.5	Feb. 8	27.6	Apr. 10	27.9	Apr. 28	33.2
Mar. 4	26.3	Feb. 11	28.5	Apr. 17	27.3		
Apr. 1	28.7	Feb. 18	27.0				
		Feb. 27	29.3				
		Apr. 19	31.6				

the premigration peak; the other 2 birds did not repeat late enough in April for this increase to be evident.

The situation in regard to females was not so clear cut. In late April, females increased in weight, but not nearly to the extent of males. Several females exceeded 30 grams but many others remained low in weight (see Figure 3). Females remaining into May were, with two exceptions, low in weight. Seven out of 15 May females were in very dull plumage and still molting; these were evidently immature birds and were very light in weight as shown in Figure 3. The other 8 females were in bright plumage, evidently having completed molting, but most showed little evident fat deposition or weight increase. Thus, even if dull-plumaged immatures were separated from bright-plumaged birds (adults), the weight curve for May would still show a downward trend.

As summarized in Table 5 the sex differential in weight is significantly greater in the spring than in midwinter, the difference, 2.1 gms, being 3 times the standard error (determined by taking the square root of sum of standard deviations squared divided by number of all 4 means). The age factor is probably

involved, since there seems to be a tendency for immature females to linger longest on the wintering grounds or perhaps winter further south and move into the area in May. However, even if the May birds believed to be immatures (see figure 3) are not included, raising the spring female average to 27.6, the difference is still of considerable statistical significance. In this connection it might be noted that female White-throats weighed by Nice (1938) during the spring migration in Ohio averaged only 26.4 grams as compared with 29.4 grams for males, a much greater sex difference than found by the same author during the fall migration.

TABLE 5

Comparison of Sex Difference in Weight During Mid-winter and Spring

	JAN. 1–FEB. 15		APRIL 15–MAY 15	
	No.	Average wt.	No.	Average wt.
Male	36	29.2 ± 1.93 gms.	26	30.8 ± 1.77 gms.
Female	21	27.5 ± 1.66 gms.	34	27.0 ± 2.10 gms.
Difference in sexes		1.7 gms.		3.8 gms.
Seasonal difference in sex difference		2.1 ± 0.697 gms.		

Discussion

It is important to note that while the winter increase in weight was a relatively gradual one, the premigration increase in males occurred within an amazingly short time. From the study so far made on collected birds it appears that fat deposition is largely responsible for both weight increases, but especially the spring one. Apparently, more than 2 grams (about 10% of body weight) of fat may be added in about a 7–10 days, the fat being largely deposited subcutaneously and underneath the ventral abdominal wall. In 1947, for example, 10 males taken between April 1 and April 17 showed no evidence of a major increase in weight, all weighing less than 30 grams. On April 19, 2 out of 5 birds exceeded 31 grams while all of a series of 5 males taken April 27–28 exceeded 31 grams, 1 individual reaching 33.9 for highest weight recorded for that year (in 1948 one February bird weighed 35 grams and one April 22 bird, 34.3 grams). In previous years when some weights were obtained at Athens, this premigration peak was largely missed because not enough individuals were obtained during the critical period of late April. Averaging weights by months or other long periods could easily obscure such a weight peak. For example, the average weight for the month of April as a whole might not be greatly different from that of winter months. Yet it is obvious that, when weights are plotted individually as in Figure 3, the weight picture for April 1 is quite different from that of any other month.

Comparison with published data for other migratory species reveals that

the White-throat weight curve for winter and spring is very similar to the "two-peaked" curve of Golden-crowned Sparrows on the west coast previously mentioned (Linsdale and Sumner 1934a). Migratory races of Oregon Junco and White-crowned Sparrow have a similar weight picture (Wolfson 1945) but migrate north much earlier in the spring; hence the winter increase and spring increase are not so well separated as in late migrant White-throat.

As has already been indicated, the general winter increase in weight as well as fluctuations during the colder months are definitely related to temperature. Males and females appear to respond equally to stimulating effect of decreasing temperature so that weight curves for both sexes are roughly parallel. In the cold period of midwinter, females come nearest to equalling males in weight. The spring increase is different and appears to be related to length of day, since Wolfson has been able to induce fat deposition experimentally in juncos (Wolfson 1942) and in White-throats (MS) by artificial lighting. In nature, temperature or other climatic factors apparently may influence the light response as is indicated by the fact that males "fattened up" and disappeared from the Athens area about 5 days earlier in the spring of 1948 when compared with 1947. In Figure 3, all records of males after April 25 are from 1947 despite the fact great effort was made in 1948 to obtain males after this time. Spring, especially March, temperatures were higher in 1948.

The unequal response of the sexes in the spring is puzzling, although it is well known that female birds in general respond more irregularly than males to experimental length-of-day increases, at least in regard to gonad recrudescence. One thing our study has definitely shown is that females remain on the wintering ground at least 2 weeks longer than males. We also discovered that these lingering females may sing, as one was shot in the act. While males responded uniformly and departed abruptly, the females showed all degrees of variation, some birds becoming fat, others not (*see* Figure 3 and note large standard deviation of spring females, Table 5). In general, late April females showed a fair degree of weight increase, while May birds did not. To the casual observer, the White-throated Sparrow disappears from the Athens vicinity about May 1, almost no birds being found on the uplands or on the University campus (only 2 birds were caught in banding traps in May). However, in the bottomland thickets small bands of females may still be found for two weeks or longer, May 18 being the latest sight record for this vicinity. These lingering females are quiet, elusive, and difficult to collect. Many of the 15 birds collected in May were dull plumaged, often still molting and were judged to be immatures; they may represent migrants from further south. In any event, most of these birds disappear from this area without "fattening up." The last bird collected (on May 14) was also the smallest on record, weighing only 22.6 grams.

Since it has been known for many years that males of many species migrate

ahead of females, it is logical to assume that females would remain on the wintering grounds longer, although this has not often been actually demonstrated. Likewise, it has been suggested that immature birds may migrate north later than adults. Since males push north when the weather may be unfavorable for the species and since males must expend a great deal of energy setting up territory, it is easy to see that a premigration deposition of fat would be of survival value. Perhaps the less extensive weight buildup (or lack of it in late migrants) in females is related to the less rigorous conditions encountered in later migration, or perhaps fat deposition does not occur until the birds are enroute. This is a question that can not be answered as yet.

Summary

During 1946–47 and 1947–48, 247 weights of White-throated Sparrows (131 from banded birds, 116 from collected birds) were obtained over the 7-month wintering period of the species at Athens, Georgia. Two distinct cycles are evident from the data, a peak in weight being reached in mid-winter and another, greater peak in males, being reached just prior to northward migration. On arrival in October, birds were lightest, males averaging 26.0, females 24.9 grams. A gradual increase occurred with winter peak being reached (in both years) in early February, males 29.8, females 28.0 grams. The winter increase seems well correlated with temperature since the coldest periods coincided with peak weights; also, birds averaged heavier in the cold 1947–48 winter as compared with warmer 1946–47 one. During late March and early April, birds underwent prenuptial molt, and weight dropped below the winter level. During the last half of April all males increased greatly in weight, averaging 30.8 grams, with a number of individuals weighing up to 33 and 34 grams. A heavy deposition of fat appears largely responsible for this increase which may occur within 7 to 10 days, or perhaps less. Virtually all males had departed by May 1. Females averaged heavier in April (27.3 gms) but the increase was much less evident than in males and the response was irregular, some females becoming quite fat, others showing little change. Females lingering into May were generally light (average 26.6), many still molting, and some, at least, being first-year birds. Apparently many females leave the Athens region before or without evident fat deposition or weight increase. For the entire spring period, April 15 to May 15, males averaged 3.8 grams heavier than females as compared with a 1.7 gram sex difference during mid-winter period, Jan. 1 to Feb. 15. The difference between these differences is statistically significant, 2.1 ± 0.69 gms.

By way of general conclusion, it appears from observational and experimental data so far available that temperature is a factor, perhaps the chief one, in bringing about the winter increase. Light, that is, length of day, is apparently the chief factor in bringing about the spring increase, temperature

being only a modifying factor. In species of birds which migrate early the significance of this difference is lost since the 2 weight peaks may coincide or be superimposed upon one another. A late migrant species, such as the White-throated Sparrow, is a more favorable subject for study since the 2 peaks are distinct and, therefore, may be studied separately. It is hoped that detailed study of collected specimens now in progress may further clarify the physiology of the temperature-correlated (winter) and light-correlated (spring) weight increases.

REFERENCES

BALDWIN, S. PRENTISS, AND S. CHARLES KENDEIGH
1938 Variations in the weight of birds. *Auk*, **55**: 416–467.
BAUMGARTNER, A. MARGUERITE
1938 Seasonal variations in the Tree Sparrow. *Auk*, **55**: 603–613.
FISHER, R. A.
1936 Statistical Methods for Research Workers (Sixth edition). London: Oliver and Boyd.
LINSDALE, JEAN M., AND E. L. SUMNER, SR.
1934a. Variability in weight in the Golden-crowned Sparrow. *Univ. of Calif. Pub. Zool.*, **40**: 309–320.
1934b. Winter weights of Golden-crowned and Fox Sparrows. *Condor*, **36**: 107–112.
NICE, MARGARET MORSE
1938. The biological significance of bird weights. *Bird-Banding*, **9**: 1–12.
WOLFSON, ALBERT
1942 Regulation of spring migration in juncos. *Condor*, **44**: 237–263.
1945 The role of the pituitary, fat deposition and body weight in bird migration. *Condor*, **47**: 95–127.

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NOTES ON NESTING PIGEON HAWKS AT PIMISI BAY, ONTARIO

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DURING the years 1946, 1947 and 1948 Pigeon Hawks, *Falco columbarius*, resided on a hill at the south end of Pimisi Bay. In 1945 Pigeon Hawks were also sighted in the same neighbourhood during spring and summer and, in all likelihood, nested in the area. While the presence of these falcons during 4 years in the same place indicates that it may have been the same pair returning each year, the male of 1948 was decidedly a darker bird than the one seen in 1947.

In 1946 my observations, covering parts of the townships of Bonfield and Calvin, District of Nipissing, disclosed an unusual number of nesting pairs where previously the species only occasionally had been noted. In 3 different localities I saw groups of juveniles at a time when their presence there could only mean that they had been reared not far from these places.

In 1945 the first Pigeon Hawk was seen on May 14 and the last on September 3, in 1946 the dates were May 17 and August 13, in 1947 April 23 and October 2, and in 1948 April 7 and October 5.

HABITAT

At Pimisi Bay, which is halfway between North Bay and Mattawa in central Ontario, the falcons' nesting grounds were located about a quarter of a mile south of the Trans-Canada Highway. To the north and east, with the exception of our home, the land is practically uninhabited. To the south, on the other hand, the Canadian Pacific Railway skirts the nesting hill and not a full mile farther on the country becomes quite densely settled with one small farm beside the other.

In general the region is rough and rocky. Its main lakes and rivers constitute an extension of the Ottawa-Mattawa river waterway and the rolling hills beyond are the northwestern end of the Laurentians. After many fires and extensive lumbering, it is now reforested by mixed second growth. The edges of these woods along clearings, creeks, rivers and lakes provide excellent nesting grounds for wood warblers, thrushes, woodpeckers and other forest-dwelling birds.

The hill that the falcons selected for their nesting was burnt over 14 years ago and a stand of dead pine trees was left, crowning the hilltop. In these the birds found the ideal perching which, according to most observers (Bent, 1938), seems to influence their choice of territory. Another circumstance, which coincides with the observations of John and Frank Craighead (1940: 241),

was that the hawk nests, both in 1947 and 1948, were close to water, in neither case more than 75 feet from the shore of Pimisi Bay.

Nesting

In 1947 I found the first nest only after the young had left. The finding of a $\frac{7}{8}$ inch pellet beneath it and the presence of flying young still being fed by their parents in the burnt-out pines just above it, established the identity of the nest beyond much doubt. It was located in a white spruce, *Picea glauca*, about 35 feet from the ground and lodged in a very bushy part of the tree, thus well concealed from all sides and from above. The tree stood at the foot of the hill on the east side and was closely surrounded by two or three of its own kind.

In 1948 the nest was found in a white pine, *Pinus strobus*, which stood on a shelf farther up the hillside, about 40 feet from the old site. The spruce had fallen during the winter and nothing was left of the earlier nest but a few scattered sticks. Both nests were built just above the middle sections of the trees, whereas the Craighead brothers (1940: 241–242), found all of their many nests located near the top, except one which was near the ground.

The new nest was built on the south side of the tree, against the trunk and supported by three stout branches, and also this time the birds had chosen the bushiest part of the tree. It was $39\frac{1}{2}$ feet from the ground and measured 35 inches in diameter with 5 inches inside depth. The nesting tree was the tallest and branchiest tree of the hillside and it stood alone on its rock shelf with scattered red pines, *Pinus resinosa*, at some little distance from it. It commanded a far view over the sheltered south bay of the lake and distant hills. To the north, a distorted tree, the remains of a *Populus grandidentata*, clung to the rocks; it sometimes served the female hawk as a landing perch on her flights to and from the nest and, occasionally, as a plucking anvil.

Behaviour at the Nest

The general pattern of the Pigeon Hawk's nesting behaviour has been rather fully described elsewhere, by Bent, (1938) in his life history of the Eastern Pigeon Hawk and by the Craigheads, (1940) in their paper, "Nesting Pigeon Hawks," and it seems unnecessary to discuss here points other than those which differ or have not been mentioned in detail in the above publications.

The male of this particular pair was not seen feeding the young. During my watches, this was done by the female only. Nor was she observed to go hunting on her own until the male disappeared when the young were about 11 days old. Up to this time, the male was seen to bring all the food, both for the female and the young.

After feedings, an hour's rest for the hunting male was almost a rule, when it would perch in the top of a burnt-out pine, immovable like a sphinx. Occasionally, particularly during incubation when less food was required, the rest

periods would extend even longer, two hours or more, when motionless perching might be interrupted by some preening or an odd flight out over the land in territorial defense.

At first the time occupied in the actual feeding of the young was on an average 5 minutes, depending on the size of the prey, up until the hawklets were about a week to 10 days old. During this time the prey brought in was usually small or, if it were larger, the female would sometimes eat part of it before she brought it to the nest. After this, the prey increased in size and then some of the feedings I witnessed took as long as from 25 to 35 minutes. A curious note came from the female while she was feeding and when she fed the young, a sharp "tick . . . tick . . . tick", quite audible from where I sat some 50 feet away. In the beginning I thought this was a kind of clicking noise of the beak, but as it did not seem to coincide with the movements of the bill it must have been a note coming from the bird's throat. When given at the nest it evidently stimulated the eager anticipation of the young.

There would be many reasons to suppose that the home territory of a raptor like the Pigeon Hawk would be a place shunned and deserted by other birdlife. But, to my surprise, I soon found that the small birds nesting near or within the hawks' territory were, and apparently remained, quite safe. In the course of time I recorded the following species nesting in the immediate vicinity: Nashville Warbler, *Vermivora ruficapilla*, Myrtle Warbler, *Dendroica coronata*, Canada Warbler, *Wilsonia canadensis*, American Robin, *Turdus migratorius*, Olive-backed Thrush, *Hylocichla ustulata*, Veery, *Hylocichla fuscescens*, Red-eyed Vireo, *Vireo olivaceus*, White-throated Sparrow, *Zonotrichia albicollis*. Of these, the Nashville Warbler had a favourite singing perch not 50 feet from the hawks' nest; the Myrtle Warbler male had a feeding ground laid out through the red pines immediately south of the nest; the Olive-backed Thrush successfully reared two young in a willow just below the shelf where the hawks' nesting tree stood; the White-throated Sparrow conducted a party of young just out of the nest through the bushes in full view of the female hawk perched on guard; the Robins repeatedly attacked the hawks with such fury that the birds of prey wobbled on their lawful perches, without lifting a wing to counter-attack.

Apart from the resident birds, small birds passing through the territory, such as Chimney Swifts, *Chaetura pelagia*, Cedar Waxwings, *Bombycilla cedrorum*, and Black-capped Chickadees, *Parus atricapillus*, also seemed to be safe. At any rate, I failed to see either the male or the female falcon take after and chase them, although the small birds sometimes passed uncomfortably close to the hawks' nest. A young Hairy Woodpecker, *Dendrocopus villosus*, on the other hand, once shone too brightly in the female falcon's eye. Whether or not, in this case, she intended to kill the woodpecker was hard to determine; her dash after it was business-like enough, but her failure

to capture the surprised and inexperienced youngster gave me the impression that her pursuit was more in the nature of a chase.

Birds the falcons obviously regarded as enemies were a Great Blue Heron, *Ardea herodias*, Crows, *Corvus brachyrhynchos*, and Hawks, *Buteo platypterus* for instance. The size of these birds seemed to be a factor in releasing the defense reaction in the small falcons. When espied half a mile away, like irate hornets the falcons dashed off, screaming, to route the intruder. By means of vicious diving attacks this was done in short order; none withstood the surprise and fierceness of the falcons' onslaught.

Squirrels and chipmunks, running freely around on the hilltop, seemed to be largely ignored like the smaller birds; but towards the larger mammals, into which category man might be included, unless overly provoked, the hawks generally adopted a defensive attitude. Once my dog, an English setter, came looking for me in my blind and the female, incubating at the time, immediately left the nest and perched on guard in the top of a nearby tree. Whenever the animal moved she followed screaming and so long as it remained on the hill the hawk did not return to the nest. My own watches were invariably spoiled as soon as the birds detected my presence and, no matter how long I then remained, they would not resume normal activities but perched on guard and screamed each time I moved. One day the female saw me coming when I was still far away and began screaming. I dove into the bush and, thinking I could fool her, hid, waiting for a while, and then made a long and laborious detour through a swamp and a dense thicket until I came to a point where I could overlook the situation. To my discomfiture I found the hawk perched in a dead tree above the thicket I had just crawled through and, a second later, she alighted screaming behind me. My entire manoeuvre was as plain to her as if I had walked through a clearing, and that day's watch was in vain. Certainly, this bird showed herself more suspicious and, in agreement with Craighead brothers (1940: 243), more aggressive than the male, especially when I approached the nest too closely. On such occasions she exhibited great excitement, screamed, dove at me headlong with anything but faked fury, while the male, with a timidity quite inconsistent with his defense behaviour towards birds larger than himself, kept at a distance and only screeched his accompaniment as the female's agitation reached a high pitch, or dashed after her in sympathetic pursuit as her gyrations brought her to the wings of the stage.

Hunting

All the hunting that I had the luck to witness was not closer to the nest than a quarter of a mile and many times I saw the falcons go hunting at far greater distances.

Twice I saw the male hunting at twilight. One time he came streaking along the highway just at the edge of the woods. Suddenly he dashed in amongst the

trees and, an instant later, he reappeared with the prey in his talons. He flew into a dead tree where he devoured it, its tousled feathers slowly floating down upon the still air. That even so fleet a hunter as this falcon could have seen, caught and killed another bird in the gathering dusk of the thicket in that split second, seemed almost incredible. Another time, at sunset, my husband and I came upon the male perched in a dead tree. Just as we stopped to watch him, he flew out in pursuit of a fluttering creature which, at first, we mistook for a bat. After some magnificent manoeuvring the hawk caught it on the wing and then returned to his perch to tear it to pieces. One of its wings fell to the ground. It was the wing of a *Polyphemus* moth.

My banding station was occasionally the scene of the falcons' hunting, but to my knowledge never with success. Once one of them came like a bullet towards my window, but within three feet of the pane it made a neat right-about turn and the chickadees scattered safely under cover. Another time I stood watching a White-throated Sparrow feeding five young. The next instant the hawk whizzed past, so close that I felt the wind of its wings on my cheek. It missed every one of the sparrows all colour-banded, which "froze" within inches of the feathered projectile.

On two occasions I happened to be in at the kill. A pair of Eastern Kingbirds, *Tyrannus tyrannus*, were feeding young, 3 days old, in a nest built at the very top of a tall spruce—the most obvious nest tended by the most conspicuous birds of the neighbourhood. The falcon came in from the lake in headlong flight, having from afar espied the female Kingbird on her way to the nest with food. Her mate, just after feeding the young, sat on a twig above the nest. Instantaneous dodging saved the female and, with a force that rocked the sprucetop, the falcon gripped the edge of the nest instead of the bird. The kingbirds, oddly inefficient, screamed and flitted around the hawk which defended itself merely by raising its wings. The hawk looked into the nest, apparently took a young in the beak and flew back with it to the hill. The whole thing happened with such lightning speed that it was only when I later computed the details of my notes and found the abruptly lowered rate of feeding that I realized the full truth of what had taken place. Two days afterwards, all the young disappeared and I can hardly suspect anyone else but the Pigeon Hawk.

The second time, I was watching a pair of Blackburnian Warblers, *Dendroica fusca*. The nest, also this time, was high up in the top of a tree and contained young, 5 days old. The female had been picking mayflies in the neighbouring tree and was flitting back to the nest when the hawk literally nailed the small bird to the nesting branch. The next second the hawk was gone and the following day, in spite of the father's continued feeding, the young warblers died from lack of motherly care and brooding.

In his life history of the Eastern Pigeon Hawk, Bent (1938: 79) quoted Brew-

ster's description of a Pigeon Hawk pursuing a Blue Jay, *Cyanocitta cristata*, which eluded capture by "dropping into a treetop, where the hawk did not attempt to attack it." In the two instances cited above, it may be noted that the hawk did not hesitate to descend into the treetops when capture on the wing proved incorrectly timed and, in the case of the kingbird, the hawk substituted on the spur of the moment the prey first aimed at but missed by another less elusive victim.

Undoubtedly the falcons thus wreaked havoc upon many nestings of the smaller birds. To make an accurate estimate of the predatory pressure they exercised upon the bird population around Pimisi Bay is, obviously, a difficult matter. The longer I watched the food habits of these hawks, the clearer it became what a surprisingly small quantity of food they actually required relative to their size and expended energy, probably due to the highly nutritious value of their diet. However, if it may be assumed on an estimate based on the feedings seen, 1 to 2 in 3 to 5 hours, and the amount of meat eaten by the young after capture, about 50 to 60 gr. a day by 2 hawklets, that each of the adult hawks, on an average, consumed 2 birds a day during 75 days and the young 3 birds a day during 50 days a total of 450 birds killed in 2½ months is reached. Had not the hunting grounds of the hawks extended over so wide an area, to a radius of at least a mile from the nest in all directions, the smaller bird population of a more restricted locality would certainly have been in danger of being wiped out.

On our lot of about 10 acres, a quarter of a mile from the hawks' nest, where I do most of my bird study, some data were obtained, which may partly be connected with the predatory pressure upon the birds breeding there. In 1947, of all nestings found in trees, 33.3% were known to have been interrupted by predatory birds which included Blue Jays, Crows and the Pigeon Hawks. Furthermore, it may be assumed that the nests abandoned for unknown reasons, 14.3%, belonged to birds which were the victims of depredation since, in most of these cases, the mate or mates in question were found to have disappeared unaccountably from their territories after the nestings were interrupted. The next year, 1948, a marked decline followed in the numbers of certain nesting birds, particularly noticeable in bright-coloured and tree-nesting passerines. For example, counted by nests found and singing males, in that year American Redstarts, *Setophaga ruticilla*, decreased from 5 to 1 pairs, Magnolia Warblers, *Dendroica magnolia*, from 4 to 1 pairs, Blackburnian Warblers from 3 to 1 pairs. Least Flycatchers, *Empidonax minimus*, which are not bright-coloured birds but apparently especially vulnerable to such hunting methods as those of the Pigeon Hawk because of their exposed flycatching habits and often rather obvious nests, decreased from 10 to 4 pairs in the same year. In 1947, only 1 of 8 Least Flycatcher nestings was successful and 3 interrupted by the disappearance of one or both of the mated birds. All 4 first nesting attempts

of 1948 were unsuccessful and, in two cases, I followed new nestings which also were interrupted for undetermined reasons. While I did not follow the nestings closely enough in 1948 to determine the exact causes of so much bad luck amongst the Least Flycatchers, I feel justified, at least in part, to put the blame on the Pigeon Hawks.

With birds nesting in holes in trees, such as woodpeckers and nuthatches, which are notoriously fair meat to the Pigeon Hawk, the picture presents itself somewhat differently. The area is a mecca for birds requiring nest sites in trees and stumps with soft cores and for comparative lack of treeclimbing predators these nestings are for the most part successful. Three pairs of Yellow-shafted Flicker, *Colaptes auratus*, nested here in 1946, but only one pair in 1947 and 1948 respectively, with a consequent decrease of flying young in these years during July and August. A notable decline in the numbers of Yellow-bellied Sapsucker, *Sphyrapicus varius*, took place as early as 1946 when pairs excavating nestholes were reduced from 3 to 1 and in 1947 there were none. On the other hand, 1948 witnessed a slight comeback of the species with 2 nesting pairs. Flying young after both these nestings were conspicuously absent, which may have been due to the death of some of the adult birds. The decline in Hairy Woodpeckers occurred in 1947, when nesting pairs were totally absent from the study area where two or three pairs had been breeding in previous years. Even an old colour-banded female, that had nested in the neighbourhood during 4 consecutive years, avoided the territory this season and no flying young were seen at any time. But in 1948 3 pairs, including the old female, produced an unusual number of young, of which 8 were banded. The same year saw a notable increase of from 1 to 3 pairs of Downy Woodpecker, *Dendrocopus pubescens*, and from 0 to 4 pairs of Red-breasted Nuthatches, *Sitta canadensis*, with a fifth pair nesting a little outside the area. In due time, most of these pairs appeared with flocks of flying young.

Although these variations in the numbers of breeding birds doubtless reflected other causes as well, a point in evidence is that, in one way or another, a compensating balance was obtained within the bird population itself, which, in the end, counteracted whatever predatory pressure may have existed upon it as a whole.

Of the prey seen in the talons of the hawks I was able to identify a mature male Purple Finch, *Carpodacus purpureus*, and the freshly severed head of a male Scarlet Tanager, *Piranga erythromelas*, was found shortly after the female hawk had been seen devouring the prey on the perch above—both species bright-coloured and tree-nesting birds. In the nest, half buried in a heap of dried excrement, the following remains were found: the leg of Cowbird, *Molothrus ater*, the right leg of Blue Jay, the left leg of Yellow-bellied Sapsucker, 2 left legs and the left wing of Yellow-shafted Flicker.

Behaviour and Development of the Young

The young hatched between June 23 and 29. Judging by their size and ability to move about when I first saw them on June 29, I calculated that they hatched on or about June 24.

I can add little to the Craighead brothers' excellent description of the young at feeding time, (1940: 244). In the nest at Pimisi Bay the 3 hawklets usually ranged themselves in a row before the female, the two largest to the left and the smallest to the right. The largest ones seemed to get the lion's share of the food, probably because they reacted more readily to the female's short quick thrusts with which she offered them the pieces of meat torn off the prey. Between feedings the young were generally quiet, but when the parent bird approached and a meal was in the offing they gave voice to their impatience with a sharp "keeyep-keeyep-keeyep-keeyep" which was quite as peevish as the adults' piercing cry, "ke*eee*yick-kyick-kyick-kyick-kyick." As the young grew older they moved about a great deal, taking little runs across the nest, flapping their wings and pushing each other, preening their thick coats of down, or fighting off swarms of small yellow wasps and bumblebees, which were attracted to the nest by the fleshy remains of the hawks' meals.

On July 5, the male hawk disappeared and the female alone was hunting and feeding the young. I suspect he had been shot either near the nest or while visiting some nearby farm. The next day a Crow alighted on the rim of the nest. The young whined and crouched down into the bottom of the nest. I must confess to a not altogether involuntary movement which scared the crow away. I expected, however, that the Crow, knowing where a good meal was to be had, would repeat the visit at a more opportune moment, but for some reason this never happened or the female may have been there to prevent calamity.

On July 12 the female apparently shared the fate of her mate. I waited in vain for her return and, finally, decided to save the young.

The rescue was achieved without incident. The young hawks threw themselves on their backs at our approach, ready to fling out their talons in self-defense, but at the age of approximately 18 days they had not yet acquired enough strength to inflict injury.

Covered with faintly bluish pearl-grey, thick, woolly natal down and with their eyes surrounded by bare skin which joined the cere at the base of the beak, like goggles, they looked like masked dolls whose droll air of defiant solemnity in a helpless situation only enhanced their goblin affinity. At this time, the two largest ones were fast losing their down and their feathers were beginning to sprout, creamy buff with dark brown, almost black, stripes on the breast, black-brown on the back, particularly on the shoulders, dark slaty brown edged with cream-buff on the tail, dark brown margined with light buff on the wings which, when spread, showed rounded cream-buff markings. The cere was

lemon-yellow with a faint tinge of greenish towards the forehead, the featherless eye-ring greenish-yellow, the iris of the eyes brown, and their legs bright yellow.

Weights and measurement were as follows:

No. 1 hawklet		*No. 2 hawklet*		*No. 3 hawklet*	
Weight	161.7 gr.	Weight	165.2 gr.	Weight	105.9 gr.
Length	217 mm.	Length	203 mm.	Length	168 mm.
Wing	119 mm.	Wing	122 mm.	Wing	92 mm.
Tail	66 mm.	Tail	52 mm.	Tail	42 mm.
Tarsus	42 mm.	Tarsus	46 mm.	Tarsus	42 mm.
Ex. Culmen	10 mm.	Ex. Culmen	11 mm.	Ex. Culmen	10 mm.

We fed the young raw meat and liver which they seemed to take quite readily. C. B. Schaughency and his wife of East Orange, New Jersey, who helped me feed them, discovered that the best way to release the gaping reaction was by offering the food with fast jerky movements, similar to the female's way of feeding them. When the food was given slowly and gently the hawklets did not seem to see it but threw themselves backwards in a defensive attitude.

Unfortunately I had to leave home on July 14 and my husband kindly took over the care of the hawks. Since his work necessitated his being away all day and as he was unable to procure fresh meat, he left a dish of canned dog-food in the cage during his absence. The hawks soon learned to feed themselves and the two largest apparently throve on the unnatural diet, but the smallest one died the day before my return, 8 days later.

At this time the hawklets were already fully feathered. Nothing remained of their natal down except a fringe of fuzz at the tip of the feathers on the shoulders and on the crown where it remained longest, like the soft frill of a bonnet. As I opened the cage to feed them, No. 2 hawklet, which, judging by the length of the tarsus, probably was a female and always proved the most precocious of the two, flew out in a flight of about 100 feet. It landed on the trunk of a pine where it clung for a few moments, then flew about 25 feet up in a tree. There it remained for a couple of hours, preening and observing the surroundings. In the evening it returned to feed at the cage, which henceforth was left open except at night. The hawklet did not remain there for the night but roosted in the tree above. Thus No. 2 left the nestcage at the age of about 4 weeks.

Three days later we banded both hawks. No. 2 was trapped as it came to the cage for food. After No. 1 was banded it remained in the cage for a couple of hours and only in the late afternoon it hopped out of its own volition and down on the ground, apparently still unable or unwilling to make as good a first flight as No. 2. It finally got up in a tree by relays and roosted there without coming down for supper.

The first week after the hawks left the cage they passed most of the day and roosted at night close to our home. During this time they indulged in consid-

erable screeching at feeding time or in play with each other and they often heralded my husband's return home at night by screeching.

I placed deer mice and raw beef on top of the cage and both hawks came down to feed 3 to 4 times during the day. No. 2 mostly stood on the cage and fed while No. 1 grasped the piece of meat in the talons and flew off with it, devouring it on a branch.

At the age of about 5 weeks, the hawks began to make training flights out over the lake and it was remarkable how fast they acquired agility and technique in flying. I removed the cage and placed the meat on a table. The hawks came to feed a little more rarely than during the first week. With a thud they alighted on the table, bobbed their heads, made a little run to grasp the meat and generally flew off with it in their talons. The meat still had to be cut up in small pieces; if the pieces were too big the hawks dropped them and would not pick them up again until replaced on the table.

At the age of 6 weeks, the hawks began to move away farther afield. Their screeching ceased almost entirely and their movements around the feeding place became silent and furtive. They made extensive training flights, mostly together, when they would wind in and out of each others' paths or chase each other at a fast clip. Feedings at the table now only occurred in the mornings or late in the evenings and it became clear that they must be supplementing these feedings with some hunting of their own. I was reasonably sure that they were not yet able to catch small mammals or birds since they were still dropping pieces of meat when too heavy and could not yet carry away a whole deermouse. My speculation on this matter was solved on August 9 when, for the first time, I watched their performance of flycatching, quite an amazing stunt by young hawks which had no parents to learn from and therefore relied entirely upon innate instinct. In a fluttering flight they rose above the treetops where insects swarmed these hot high-summer days, caught their prey by dint of twists and swoops, dropped back on to a branch in some dead tree, smote the prey to pulp and devoured it. By this time, the hawks had found their way back to their true home-grounds on the burnt hill and it was here at night that I now saw them most often.

Throughout the last weeks in August I saw them at different places, once as far as a mile from our home. They still returned for meat at the table. Now they no longer alighted but dove on the table, seizing the meat in passing with their talons. Once No. 2 dropped a piece on the upswing and deftly recaught it in mid-air. Gradually, their visits became rarer, sometimes with several days in between until, on August 29, both perched above the feeding table, looking down for a last meal.

On September 2, I encountered one of them hunting in a place where a pair of American Goldfinches, *Spinus tristis*, were feeding young just out of the nest. The goldfinches behaved with obvious distress and soon afterwards were seen departing with at least one of their young missing. Thus I drew the conclusion

that the young falcon had, at last, fully graduated in the hunting techniques of its species.

Summary

A resume is presented of notes on Pigeon Hawks which nested in the same place at Pimisi Bay, Ontario, during at least three years in succession. The habitat was a burnt-over hill near the lake and the nests found were placed a little above the middle-sections of coniferous trees.

The male falcon did most of the hunting and brought food to the female which, in turn, fed herself and the young. The hunting hawk usually took at least an hour's rest before going out on another hunting trip. Small birds and mammals on the hawks' nesting territory were apparently ignored, but larger birds and mammals were not tolerated. It is indicated that the hunting pressure of the hawks upon the smaller bird population was counteracted by two main factors, the extension of their hunting grounds and what seemed to be compensating fluctuations within the bird population itself.

The young hawks, raised by hand for a week after their parents' disappearance, left the nest cage at about 4 weeks of age and reached full independence about 5 weeks later.

In the writing of this paper I am greatly indebted to Mr. W. Earl Godfrey, National Museum of Canada, for his kindness in helping me with the identification of the debris found in the nest. I further owe thanks to Dr. Josselyn Van Tyne for kindly arranging for me the loan of the literature cited below from the Wilson Ornithological Club Library and grateful appreciation to Dr. J. M. Speirs and Mrs. Doris Huestis Speirs for their encouragement, suggestions and criticism with regard to this manuscript.

REFERENCES

Bent, Arthur Cleveland
1938 Life histories of North American birds of prey, (part 2). *U. S. Natl. Mus. Bull.*, **170:** 70–83.

Craighead, John and Frank
1940 Nesting Pigeon Hawks. *Wils. Bull.*, **52:** 241–248.

Rutherglen, Ontario, Canada

ECOLOGY OF A NESTING RED-SHOULDERED HAWK POPULATION

ROBERT E. STEWART

AN ECOLOGICAL study of the Northern Red-shouldered Hawk (*Buteo lineatus lineatus*) was made on the Coastal Plain of Maryland in Prince Georges and Anne Arundel Counties during the spring of 1947. The objective was to gain information on habitat requirements, population densities, reproductive rate, food habits, and other factors relating to the nesting, survival, and environmental relationships of this species.

Field data accumulated during this investigation form the basis for most of the information in the present paper. However, supplemental data from observations on the Patuxent Refuge during the preceding 4 years are also included. In the field work during 1947 the author was assisted by R. Bruce Overington and Alvis K. Melton. James B. Cope helped with the studies on the Refuge during the preceding years. Grateful acknowledgment is also made to William H. Stickel who identified fragments of mammals, reptiles, and amphibians found in several pellets taken from the Red-shouldered Hawk nests.

The 1947 study area (Fig. 1) comprising about 185 square miles, included almost the entire watershed of the Patuxent River from the fall line (natural boundary between Piedmont and Coastal Plain) down the river valley to a point near the upper limits of tidewater.

In this region the conspicuous courtship maneuvers of the Red-shouldered Hawk generally first become noticeable during the last week in February and continue through March and the first half of April. Nests are completed during the earlier part of this period and the eggs are usually laid between March 20 and April 10. In most cases, the hatching period occurs during the last 10 days in April and first 10 days in May. The young birds leave the nest sometime during the first 3 weeks of June.

HABITAT REQUIREMENTS

On the Coastal Plain of Maryland a combination of fairly extensive flood-plain forests with adjacent clearings appears to meet the major ecological requirements of the Red-shouldered Hawk during the nesting season. Within the study area this habitat combination was found to occur only along the Patuxent River and a few of its larger tributaries. These hawks were almost entirely absent in upland forested areas or in clearings that were situated more than .25 mile from flood-plain forests.

The flood-plain forests differ considerably from most of the upland forests in this region (Hotchkiss and Stewart, 1947). The overstory of the flood-plain

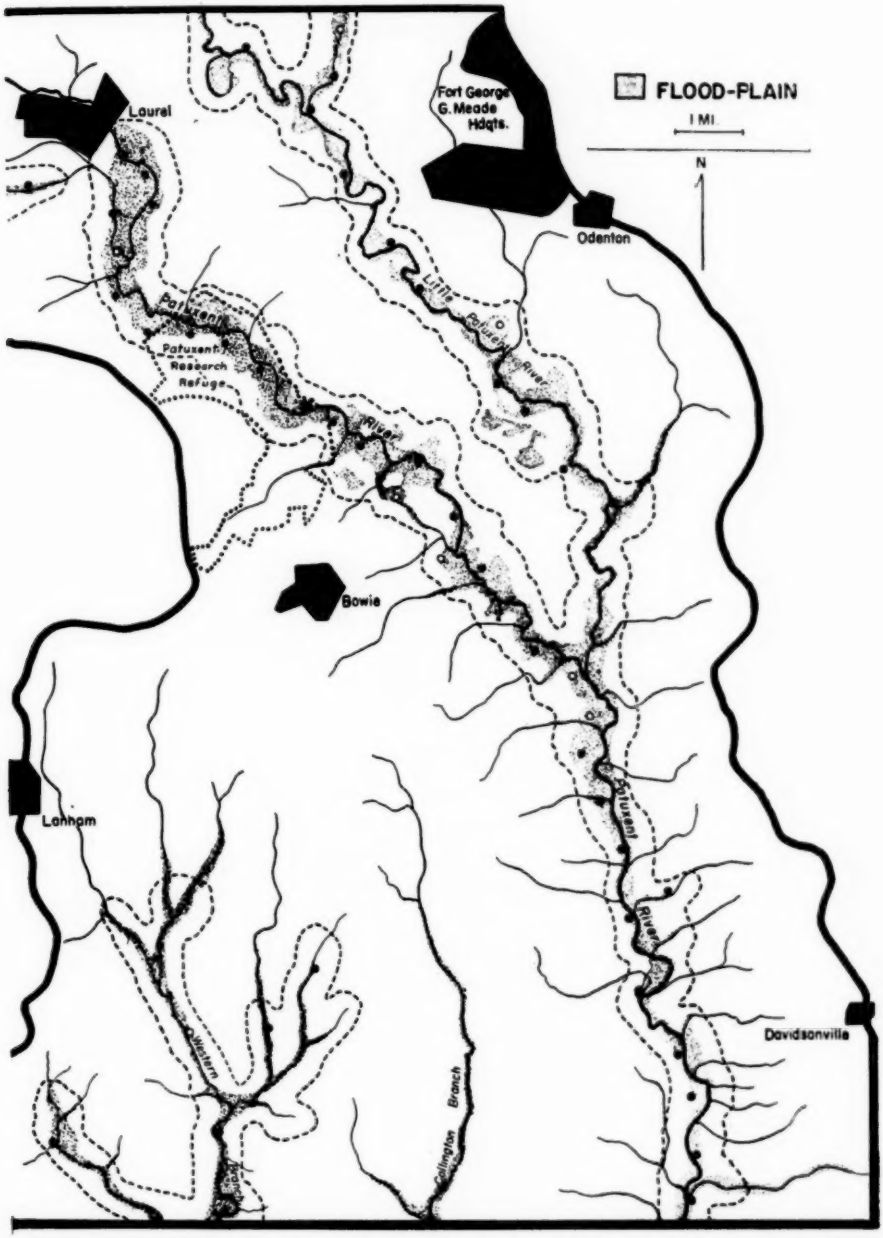

FIG. 1—Map of 1947 Study Area Showing Distribution of Pairs of Nesting Red-shouldered Hawks. The solid circles show the nest locations, while the open circles represent the approximate centers of territories of pairs whose nests were not found. The dashed lines represent the approximate boundaries of the areas that were inhabited by Red-shouldered Hawks, and the outer heavy line represents the boundary of the study area.

forests consists of a considerable variety of deciduous trees, the more important of which are: Sweetgum (*Liquidambar styraciflua*), River Birch (*Betula nigra*), Pin Oak (*Quercus palustris*), Red Maple (*Acer rubrum*), Tulip-tree (*Liriodendron tulipifera*), Beech (*Fagus grandifolia*) and Hornbeam (*Carpinus caroliniana*). Most of the upland deciduous forests are dominated by various species of oak (*Quercus* spp.), although locally, hickories (*Carya* spp.) and Tulip-tree are common. Virginia Pine (*Pinus virginiana*) and Pitch Pine (*Pinus rigida*) are often prevalent on upland areas that have been retired from agriculture.

In general, the Red-shouldered Hawk, throughout its range, occurs in moist, well-drained woodlands or in wooded river swamps during the nesting season. In the New York City region it prefers "richer lowlands where damp woods border on fields and marshes" (Cruickshank, 1942). It is usually far more common in lowland areas than in mountainous regions and prefers the borders of streams, lakes or swampy woods. In Massachusetts this species occurs regularly in the hardwood region of the southeastern part of the State as well as in the White Pine region to the north; and in Florida, the Florida Red-shouldered Hawk (*Buteo lineatus alleni*) "seems to be equally at home in extensive flat pine woods and in the dense live-oak hammocks" (Bent, 1937). In California, the California Red-shouldered Hawk (*Buteo lineatus elegans*) "is essentially a bird of the lower wooded river bottoms between sea level and 1200 feet" (Dixon, 1928) although Sharp (1906) found that it also showed a fondness for Eucalyptus groves.

Population Density

A census of nesting Red-shouldered Hawks in the 1947 study area (185 square miles) was conducted by attempting to locate the nest of each pair in the area, or failing that, to determine the boundaries of its nesting territory. The search for nests was carried out in late March and April before most of the leaves on the deciduous trees had appeared. A large proportion of the study area is open farm land which was covered quickly and satisfactorily by using an automobile. All wooded areas of any size were covered carefully on foot and many were revisited several times—especially when the terrain and vegetation appeared suitable for Red-shouldered Hawk habitation. Nest records and other observations pertaining to population densities and ecology of this species were plotted on War Department Quadrangle Maps ($7\frac{1}{2}$-minute series) that covered the area being studied.

A total of 51 pairs were located within the area and for 43 pairs, occupied nests were found. These 51 pairs ranged over approximately 42 square miles of territory or about 23% of the entire study area (185 square miles). The thoroughness of the coverage of the study area together with the fact that this species is quite conspicuous during the early part of its nesting season, makes it seem unlikely that any pairs were missed.

The population density for the part of the area (42 square miles) occupied by this species was about one pair per .8 of a square mile, while the density for the entire 185 square miles included in the study area would be 1 pair per 3.6 square miles. On an average the territory of each pair included about 160 acres of flood-plain forest which represented one-third of the total area included in the territory.

By referring to the map of the study area (Fig. 1), it may be seen that the nests or territorial centers were distributed fairly regularly over most of the flood-plain forests. This regularity in spacing is especially well marked in areas where the width of the flood-plain is relatively constant. In one such area the average intervening distance between 8 adjacent nests was .56 mile, while the maximum distance was .65 mile and the minimum .45 mile. The minimum distance in this case also represents the shortest distance between any 2 occupied nests in the entire study area.

TABLE 1

Distance Between Nests as Related to Width of Flood Plain

FLOOD PLAIN	MEAN WIDTH (IN MILES) OF FLOOD PLAIN (BASED ON MEASUREMENTS TAKEN AT ½ MILE INTERVALS)	DISTANCE BETWEEN NESTS (OR TERRITORIAL CENTERS) IN ADJOINING TERRITORIES		NUMBER OF NESTS (OR TERRITORIAL CENTERS)
		Mean distance (in miles)	Standard deviation	
Patuxent River (Upper two-thirds)	.48	.67	.22	22
Patuxent River (Lower one-third)	.28	.88	.19	8
Little Patuxent River	.20	.98	.24	10
Western Branch	.12	1.34	.24	6

In general, the distances between nests of adjacent pairs were found to vary inversely with the average width of the flood-plain (table 1). The 8 adjacent nests mentioned above, which averaged .56 mile apart, were located along one section of the Patuxent River where the average width of the flood plain was .53 mile. Along one fairly uniform stretch of the Little Patuxent River the average width of the flood plain was approximately .16 mile and here the intervening distances between 8 adjacent nests averaged about .96 mile.

A noticeable break in the distribution of nests or territories occurred along the lower course of the Little Patuxent River. Here the habitat conditions appeared to be entirely suitable and several old nests were found, although not a single Red-shouldered Hawk was seen or heard. Since this locality is popular for its hunting and fishing it is quite possible that the resident hawks had been shot out.

Bent (1937) found this species to be much more common in Florida than elsewhere. Along the Kissimmee River, 65 nests were found in an area 10 miles long by 5 miles wide, in a single season. On the basis of the nests found, the

population density for this area (about one pair per .8 of a square mile) is practically identical to the density found in the 42 square miles inhabited by this species in the Maryland study area. It appears that this figure would approximate the minimum breeding density of the Red-shouldered Hawk where it occurs under optimum environmental conditions.

Apparently the breeding population density of this species is generally somewhat greater in the southern States than it is in other parts of its range. Along the Nueces River in Texas, Hahn (1927) reported that nests were usually from .25 to .50 mile apart. In one clump of trees about .50 mile square he found 5 nests. In southern Florida, Nicholson (1930) found that 2 pairs rarely used the same hammock, although on 2 occasions he found nests a few hundred yards apart. In the Buckeye Lake Region, Ohio, during the period 1922–24, Trautman (1940) found that the Red-shouldered Hawk population averaged slightly more than 22 pairs per year on an area that covered a little less than 44 square miles (1 pair per 2 square miles). In California, Dixon (1928) had a record of 23 nesting locations within a radius of 30 miles of Escondido, which he believed was all that the food supply of the area would warrant. Since the population density of this species is closely correlated with habitat conditions, its probable greater abundance in the southern States may be due to the extensive swamp forests that occur so commonly there. Elsewhere the required habitats of this species are more local and restricted in size.

Nest Sites

All of the nests found during this investigation were located in forested stream valleys. Fifty-one nests were on the flood plain while six nests were found on fairly steep river bluffs. Most of the nests were built in rather large trees. The D.B.H. measurements of the nest trees ranged from 1–4 feet and averaged about 2 feet. The height of the nests above the ground varied considerably, the lowest being 28 feet, the highest 77 feet, and the average about 50 feet. Roughly 90 percent of the nests were built in crotches of the main trunks, the remainder being situated in crotches of branches off the main trunks. One nest was suspended between limbs about one foot above an upright crotch, while another had been constructed on top of an old squirrel nest. Almost half of the nest trees had a fairly dense growth of Poison Ivy (*Toxicodendron radicans*) clinging to them. The nests were situated in a considerable variety of deciduous trees. These are listed as follows:

River Birch (*Betula nigra*)—13 nests
Pin Oak (*Quercus palustris*)—9 nests
Beech (*Fagus grandifolia*)—8 nests
Sycamore (*Platanus occidentalis*)—5 nests
Tulip-tree (*Liriodendron tulipifera*)—4 nests
Red Ash (*Fraxinus pennsylvanica*)—3 nests
Sweetgum (*Liquidambar styraciflua*)—3 nests

Red Maple (*Acer rubrum*)—3 nests
White Oak (*Quercus alba*)—3 nests
White Ash (*Fraxinus americana*)—2 nests
Willow Oak (*Quercus phellos*)—1 nest
Southern Red Oak (*Quercus falcata*)—1 nest
Black Oak (*Quercus velutina*)—1 nest
Swamp Chestnut Oak (*Quercus prinus*)—1 nest

Some preference may be indicated for certain species in this list. Although the first three, River Birch, Pin Oak, and Beech are among the more common species in the flood-plain forest, Sweetgum and Red Maple are equally as common and yet lag well behind in the number of nests that were situated in them. The reasons for such preferences, if they do exist, were not apparent.

Nests of the Red-shouldered Hawk have been found in a considerable variety of deciduous trees throughout its range (Bendire, 1892; Bent, 1937; Dixon, 1928; Trautman, 1940). In the northeastern states they also occur commonly in pine and occasionally in Hemlock, while in the southeastern and gulf states they have been found in pine, cypress, Cabbage Palmettos, Black Mangrove, and various species of broad-leaved evergreen trees (Bent, 1937; Kennard, 1894; Todd, 1940). In California the nests are frequently built in Eucalyptus trees as well as in the bottomland hardwoods, while in Lower California they have even been found in giant cactus and candlewood (Bendire, 1892; Dixon, 1928; Sharp, 1906). In general, the height of the nests above the ground in different parts of its range appear to be similar to those found in the Maryland area, except that nests in the extreme southern part of the range (southern Florida and Lower California) appear to average somewhat lower than those to the north. This may be a reflection of an average lower height of suitable trees in these southern areas. The lowest measurements were 2 nests 10 feet above the ground, 1 in a buttonwood in southern Florida (Bent, 1937) and 1 in a sumac bush in Lower California (Bendire, 1892), while the highest was 1 nest 85 feet above the ground, situated in a Sycamore in California (Dixon, 1928).

Association and Competition with other Raptores

The absence of Red-shouldered Hawks along Collington Branch (Fig. 1) might have been due to the presence there of 2 nesting pairs of the Eastern Red-tailed Hawk (*Buteo jamaicensis borealis*). A few scattered pairs of Red-tailed Hawks were found throughout the study area, although most of them occurred on the upland away from the stream bottoms, so that ordinarily there was probably very little competition between the two species. The habitat requirements of the Northern Barred Owl (*Strix varia varia*) and the Red-shouldered Hawk must be very similar since they were commonly found associated together in the same areas. However, no evidence of any antagonism between them was noted. On the Patuxent Research Refuge in 1943, a Red-shouldered Hawk nest was found only 160 feet from an occupied Barred Owl nest. Other nesting

raptores which occurred in the study area, including the Great Horned Owl (*Bubo virginianus virginianus*), Cooper's Hawk (*Accipiter cooperi*), Broad-winged Hawk (*Buteo platypterus platypterus*), and Eastern Sparrow Hawk (*Falco sparverius sparverius*), were all largely restricted to habitats on the upland, and therefore had little opportunity to compete with the Red-shouldered Hawk.

In Massachusetts, Bent (1937) found the Red-shouldered Hawk and Barred Owl to be "tolerant, complementary species, frequenting similar haunts and living on similar food, one hunting the territory by day and the other by night." On the other hand, he noticed that the Red-tailed Hawk and Red-shouldered Hawk seemed to represent competitive and antagonistic species which apparently never nest near each other.

TABLE 2
Contents of Red-shouldered Hawk Nests

YOUNG	NESTS	
4	10	
3	17	
2	16	(two of which also contained single sterile eggs)
1	4	(one also containing 2 sterile eggs and another one sterile egg)
?	2	(contained young but not examined closely)
deserted	3	
127+	52	

Reproductive Rate

Most of the nests were found during the nest-building, egg-laying, or incubation periods and were not examined closely until after the young had hatched. At the time of climbing to the nests, nearly all of the young had completed half or more of their growth. Out of 52 nests (table 2) which were revisited at this stage, only 3 (6 percent) were found to be deserted. The number of young in the nests which were still occupied ranged from 1–4 and averaged 2.7. Four of the nests with young also contained sterile eggs, 3 nests being found with single eggs and 1 nest with 2 eggs.

Very little could be found in the literature on the number of young Red-shouldered Hawks in nests following hatching, although there is considerable information on the number of eggs that are laid. In the northeastern and north-central states (Bent, 1937; Todd, 1940; Trautman, 1940) 3–4 eggs are usually laid, with 3 being more common than 4. Two eggs are occasionally laid and very rarely sets of 1 or 5 eggs may be found. Bendire (1892) even records 2 sets of 6. In Texas and California (Bent, 1937; Dixon, 1928; Hahn, 1927; Sharp, 1906) 3 eggs are generally laid although sets of 2 are fairly common and occasionally sets of 4 are found. In Florida (Bent, 1937; Nicholson, 1930), the usual number of eggs is 2, although 3 are occasionally found and very rarely 4. These data bear out

the conclusions of Lack (1947), that many species tend to lay more eggs in the northern than in the southern part of their range. In this respect, the Red-shouldered Hawks in Maryland are similar to those in California and Texas, being intermediate between the birds of Florida on the one hand and the birds of the north-central and northeastern states on the other.

Food Habits of Nestlings

During the course of this study, a total of 43 food items of about 23 different kinds were taken from 17 nests. These were in the form of freshly killed prey, as older fragments in the nest debris, or as parts of regurgitated pellets. On the basis of occurrence of these food items, reptiles comprise 37 percent (16 items) of the food, mammals 33 percent (14 items), birds 19 percent (8 items), amphibians 9 percent (4 items), and insects 2 percent (1 item). A more detailed breakdown of these foods follows:

Food of Nestling Red-shouldered Hawks

(Percentages Based on Occurrence of Food Items)

Mice, Moles, and Shrews	23%
4 Field Mice (*Microtus pennsylvanicus*)	
2 unidentified mice (Microtinae)	
2 Star-nosed Moles (*Condylura cristata*)	
1 Common Mole (*Scalopus aquaticus*)	
1 Short-tailed Shrew (*Blarina brevicauda*)	
Snakes	19%
6 unidentified snakes (3 Colubridae, 3 Natricinae)	
1 Water Snake (*Natrix* sp.)	
1 Ground Snake (*Haldea valeriae*)	
Small Birds	14%
3 unidentified birds	
2 Indigo Buntings (*Passerina cyanea*)	
1 warbler nest stained with blood	
Lizards	14%
3 Race Runners (*Cnemidophorus sexlineatus*)	
1 Blue-tailed Skink (*Eumeces fasciatus*)	
1 unidentified Skink (*Eumeces* sp.)	
1 unidentified lizard (Scincidae)	
Rabbit	9%
4 Cottontail Rabbits (*Sylvilagus floridanus*)	
Frogs and Toads	9%
2 American Toads (*Bufo americanus*)	
1 Wood Frog (*Rana sylvatica*)	
1 unidentified frog	
Game Birds	5%
1 Mourning Dove (*Zenaidura macroura*)	
1 Bob-white (*Colinus virginianus*)	
Small Snapping Turtles	5%
2 Snapping Turtles (*Chelydra serpentina*)	
Beetles	2%
1 unidentified beetle (Coleoptera)	

Detailed observations of food habits of Red-shouldered Hawk nestlings at 16 nests in New York State (Ernst, 1945) were analyzed as follows: mice and rats (principally *Microtus*)—58%; amphibians (principally Leopard Frogs and sala-

manders)—18%; insects (mostly grasshoppers, beetles, and caterpillars)—10%; small birds—8%; reptiles—3%; and miscellaneous items—3%. One young domestic duckling brought to a nest was the only authentic case of poultry being taken in 4 years. In western Pennsylvania (Todd, 1940) "the young are fed on mice and other small mammals, frogs, crayfish, insects, snakes, and occassionally small birds." In South Carolina, Wayne (1910) writes that "during the breeding season this hawk frequently catches chickens and even grown fowls, but its principal food is mice, frogs, and snakes."

Besides the records just mentioned, scattered observations of the food habits of nestling Red-shouldered Hawks have been recorded in Massachusetts (Bent, 1937; Hersey, 1923; Kennard, 1894), California (Dixon, 1928; Sharp, 1906), Texas (Hahn, 1927), Wisconsin (Errington, 1933), and New York (Chapin, 1908). On the basis of the occurrence of 52 items thus recorded, mice, rats, shrews, and moles comprise 27% of the food, small birds 17%, frogs 15%, snakes 14%, gallinaceous birds (including poultry) 8%, rabbits and squirrels 6%, and miscellaneous items 13%.

All of these observations, including the records obtained in the present study, help to illustrate the diversified diet of these young carnivorous birds.

Summary

An ecological study of a nesting Red-shouldered Hawk population was made over a 185 square mile area on the Coastal Plain of Maryland in 1947. The courting and nesting season extended from late February until late June.

During the nesting season a combination of fairly extensive flood-plain forest with adjacent clearings appears to meet the major ecological requirements of the Red-shouldered Hawk in this region. A total of 51 pairs was found in the study area, occupying about 42 square miles or 23% of the total area studied. The population density on the land that was suitable for this species was about 1 pair per .8 of a square mile, while the density for the entire study area would be only about 1 pair per 3.6 square miles.

Nests were spaced fairly evenly over most of the flood-plain forests, especially in areas where the width of the flood plain was relatively constant. There was an inverse correlation between the width of the flood plain and the distances between nests in adjacent territories. The nests were all situated in fairly large trees and were from 28 feet to 77 feet above the ground, averaging 50. They were found in 14 different species of trees, all deciduous.

The Barred Owl and Red-shouldered Hawk were commonly associated together in the same lowland habitats. Other raptores were all largely restricted to upland habitats.

The average number of young in 47 occupied nests following the hatching period was 2.7 with extremes of 1 and 4. Only 3 out of 52 nests (6%) were found deserted at this time.

The food habits of nestling Red-shouldered Hawks are very diversified. They feed on many types of warm-blooded and cold-blooded vertebrates as well as invertebrates.

REFERENCES

BENDIRE, CHARLES EMIL
1892 Life histories of North American birds. *U. S. Nat. Mus. Spec. Bull. 1.*

BENT, ARTHUR CLEVELAND
1937 Life histories of North American birds of prey (Part 1). *U. S. Nat. Mus. Bull. 167.*

CHAPIN, JAMES
1908 Nests of the Barred Owl, Red-shouldered Hawk and Barn Owl on Staten Island in 1907. *Proc. Staten Island Assoc. Arts and Sciences*, **2:** 6–7.

CRUICKSHANK, ALLAN D.
1942 Birds around New York City. *Am. Mus. Nat. Hist. Handbook Series* No. 13.

DIXON, JAMES BENJAMIN
1928 Life history of the Red-bellied Hawk. *Condor*, **30:** 228–236.

ERNST, STANTON G.
1945 The food of the Red-shouldered Hawk in New York State. *Auk*, **62:** 452–453.

ERRINGTON, PAUL L.
1933 Food habits of southern Wisconsin raptores. *Condor*, **35:** 19–29.

HAHN, WILLIAM, JR.
1927 Florida Red-shouldered Hawk. *Oologist*, **44:** 141–142.

HERSEY, FRANK SEYMOUR
1923 A nesting Red-shouldered Hawk's hearty meal. *Auk*, **40:** 693.

HOTCHKISS, NEIL AND ROBERT E. STEWART
1947 Vegetation of the Patuxent Research Refuge, Maryland. *Amer. Mid. Nat.*, **38:** 1–75.

KENNARD, FREDERICK HEDGE
1894 The habits and individualities of the Red-shouldered Hawk in the vicinity of Brookline, Mass. *Auk*, **11:** 197–210.

LACK, DAVID
1947 The significance of clutch-size. *Ibis*, **89:** 302–352.

NICHOLSON, DONALD JOHN
1930 Habits of the Florida Red-shouldered Hawk. *Wilson Bull.*, **42:** 32–35.

SHARP, CLARENCE SAUGER
1906 Nesting of the Red-bellied Hawk. *Condor*, **8:** 144–148.

TODD, W. E. CLYDE
1940 Birds of western Pennsylvania. *Univ. of Pittsburgh Press.*

TRAUTMAN, MILTON B.
1940 Birds of Buckeye Lake, Ohio. *Misc. Publ. Mus. Zool. Univ. Michigan, No. 44.*

WAYNE, ARTHUR TREZEVANT
1910 Birds of South Carolina. *Contr. Charleston Mus. No. 1.*

PATUXENT RESEARCH REFUGE, U. S. FISH AND WILDLIFE SERVICE, LAUREL, MARYLAND.

A COMPARATIVE STUDY OF NESTING BIRDS IN A FIVE-ACRE PARK

HOWARD YOUNG

THIS paper presents quantitative data on the size and nesting success of a breeding population of birds in a five-acre park land area; it traces the changes in this population and its reproductive fortunes through a complete breeding season, and compares the breeding cycles, the nest density, and the success of the various species composing it.

The material is based on observations made during the spring and summer of 1947 at Ho-Nee-Um Pond, a small portion of the University of Wisconsin Arboretum, in the vicinity of Madison, Wisconsin. By means of frequent searches (almost daily in spring, later about twice a week) a high percentage of the nests on the area was found, and it was possible to trace the history of most of these through the nesting cycle. Approximately 250 man-hours were spent in the field. Mean temperatures for the study period averaged 2.2 degrees below normal during March through July. August was the hottest ever recorded for the Madison region, 8.8 degrees above normal, and September was slightly above normal. Precipitation for the study period was 2.89 inches above normal.

Acknowledgment for assistance in nest searching and examination is made to Carl Strelitzer, Ernest Boyce, Robert McCabe, James Hale, and Arnold Jackson, Jr. Acknowledgment is made to Professor John T. Emlen Jr. for helpful suggestions and for a critical reading of the manuscript.

DESCRIPTION OF THE AREA

The Ho-Nee-Um Pond area (Fig. 1) is a low-lying park on the northwest shore of Lake Wingra. It is roughly trapezoidal in shape and has an area of 5.2 acres. The 2 main plant communities are a mowed lawn of blue grass (*Poa spp.*) covering about 40% of the total area, and numerous plantings of closely spaced arbor vitae (*Thuja occidentalis*), covering about 26% of the total area. These plantings are arranged in irregular patterns, making for extensive environmental edges with the grass area.

The arbor vitae varies in height from 5 to 30 feet, with the average tree about 15 feet high. Mixed with it are scattered patches of red osier dogwood (*Cornus stolonifera*) and staghorn sumac (*Rhus typhina*), and lesser amounts of white birch (*Betula alba*), elderberry (*Sambucus canadensis*), ninebark (*Physocarpus opulifolius*), box elder (*Acer negundo*), honeysuckle (*Lonicera tatarica*), hawthorn (*Crataegus sp.*), and highbush cranberry (*Viburnum opulus*). The ground cover under the plantings is mainly blue grass, nettle (*Urtica sp.*), thistle (*Cirsium sp.*), and burdock (*Arctium sp.*). The vegetation beneath the arbor vitae was cut

once, in May, with scythes. Late in the season there were solid beds of swamp milkweed (*Asclepias incarnata*) along some of the edges.

The northeastern corner of the area contains a small group of black locust (*Robinia pseudo-acacia*). The lake shore is lined by occasional cottonwoods

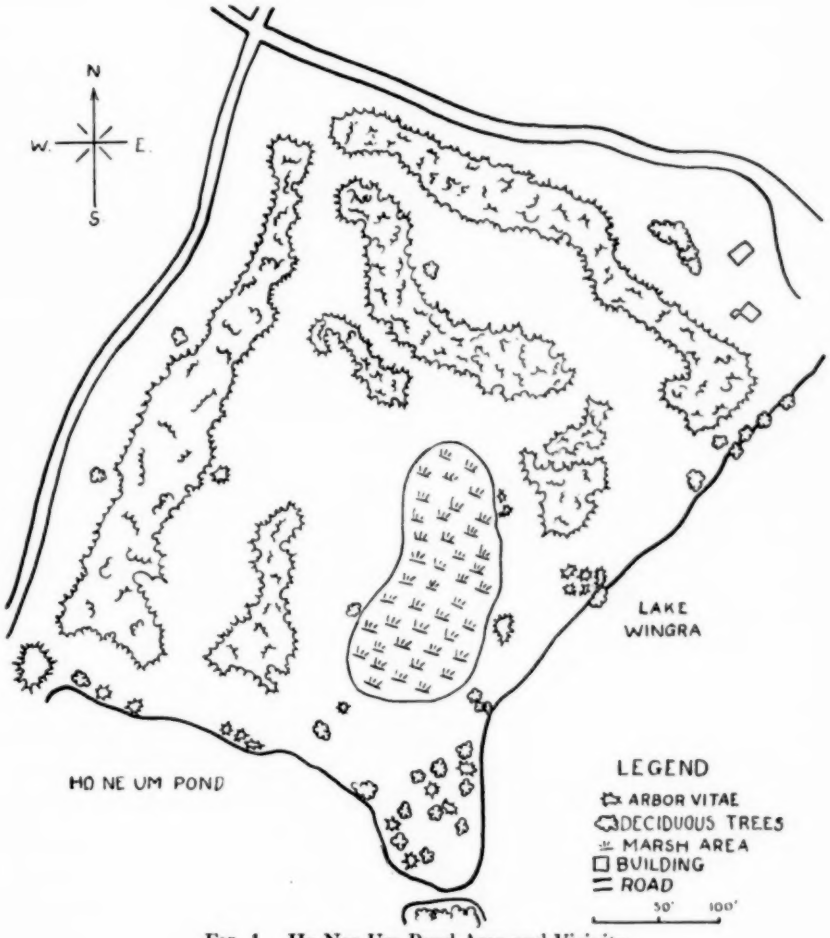

FIG. 1. Ho-Nee-Um Pond Area and Vicinity

(*Populus deltoides*), and there is a thick clump of black willow saplings (*Salix nigra*) in the southwest corner. Near these is a small swampy pond of approximately .3 acres, thickly grown to sedge (*Carex sp.*), with a few patches of cattail (*Typha latifolia*) and reed grass (*Phragmites communis*). The grass contains liberal amounts of dandelion (*Taraxacum officinale*) and plantain (*Plantago major*).

Nest Density and Nesting Chronology

The nesting population of the area is summarized in Table 1. Unless otherwise designated all the data refer to "active" nests (those in which at least one egg was laid). In addition to the species listed, the Cowbird (*Molothrus ater*) bred as a parasite of the Alder Flycatcher, Cedar Waxwing, Yellow Warbler, Rose-breasted Grosbeak, and Song Sparrow. Figure 2 presents the same material in graphic form; in this case, however, only nests actually found were considered.

The high density, ranging up to 9.6 nests per acre (May 19–May 20) is considered of special interest. This is probably due to the great interspersion of plant types, and the large amount of "edge" as shown in Figure 1. There are approximately 5000 feet of arbor vitae-grass edge in the area.

Computed according to the usual manner, i.e., the total number of nests on the area during the season, the density was 164 nests, or 32.8 per acre. This is referred to as "Total Nest Density" in Table 1. These nests represent approximately 94 breeding pairs, a density of 18.5 per acre. Steinbacher (1942) found 111 pairs of birds nesting in the 19 acre Frankfort Zoo park. This density of 5.8 pairs per acre, while only one-third that of Ho-Nee-Um, was considered to be especially high. There do not appear to be other comparable studies in areas of similar size for comparison.

The density data were further analyzed by comparing them from month to month. This showed extensive fluctuations as some species ended their nesting and others started (Figure 2). Following are the average daily densities in nests per acre for the months covered by this study: April—3.5, May—8.6, June—6.0, July—4.8, Aug.—2.1, Sept.—.6. The overall average was 4.3 nests per acre.

It would seem that "Highest Nest Density" (Table 1–D) has a particular significance. Other workers have usually computed what is shown in Table 1 as "Total Pair Density" (Col. F) and "Total Nest Density" (Col. C). These are valuable as indices to the population, but computing the highest nest density has the advantage of showing the greatest nesting population at any one time, and as such is better suited for investigations of the various problems related to social competition such as density tolerance, density-induced behavior, reproductive success, etc.

Inter-specific strife was very low even during the periods of highest density. Of the two most abundant species, Bronzed Grackles and Robins, the Grackles exhibited no recognizable territorial behavior; Robin territories were poorly defined and defended with indifferent vigor (Young: 1947). The other species were not observed sufficiently to draw conclusions regarding territorial behavior.

In Figures 2 and 3, the numbers and stages of the nests shown were determined partly by daily examination, and partly by interpolation and extrapolation. Nests in various stages of the cycle were followed, and averages based on all records were determined for the length of time in each phase. When a new nest

TABLE 1
Species Nesting at Ho-Nee-Um Park, 1947

SPECIES	A Nests found	B Estimated total of nests	C Total nest density	D Highest nest density	E Total no. of pairs (estimated)	F Total pair density
Bronzed Grackle *Quiscalus quiscula*	26	28	5.6	4.2	21	4.2
Robin *Turdus migratorius*	36	37	7.4	3.8	19	3.8
Catbird *Dumetella carolinensis*	22	22	4.4	2.2	11	2.2
Cedar Waxwing *Bombycilla cedrorum*	14	16	3.2	1.6	8	1.6
Yellow Warbler *Dendroica petechia*	12	12	2.4	1.4	7	1.4
Goldfinch *Spinus tristis*	9	9	1.8	1.2	6	1.2
Song Sparrow *Melospiza melodia*	2	15	3.0	.5	5	1.0
Mourning Dove *Zenaidura macroura*	11	11	2.2	1.0	5	1.0
Alder Flycatcher *Empidonax traillii*	5	5	1.0	.6	3	.6
Mallard *Anas platyrhynchos*	1	2	.4	.2	2	.4
R. N. Pheasant *Phasianus colchicus*	2	2	.4	.2	2	.4
Killdeer *Charadrius vociferus*	1	1	.2	.2	1	.2
Rose-Br. Grosbeak *Pheuticus ludovicianus*	1	1	.2	.2	1	.2
Chipping Sparrow *Spizella passerina*	1	1	.2	.2	1	.2
Warbling Vireo *Vireo gilvus*	0	1	.2	.2	1	.2
Yellowthroat *Geothlypis trichas*	0	1	.2	.2	1	.2
Total	143	164	32.8	9.6	94	18.5

C & F computed from B & E.
D—highest density at any one time; computed from A.
C, D, & F computed on a per-acre basis.

was found it was thus possible to determine fairly accurately the date on which it was started. For example, observations showed that Robins took about 7 days on an average to build their nest; it then remained empty for an average of 4 days, after which the eggs were laid at the rate of 1 a day. A Robin nest found to contain 2 eggs on April 20 was therefore tallied as having been started on April 7, since 13 days were necessary to bring it to the 2-egg phase of the cycle. In most cases it was only necessary to extrapolate 3 or 4 days. About 35% of the material presented in the figures was thus computed.

The efficiency of nest searches was tested by comparing the extrapolated totals of any given day with the number of nests actually known on that day. On this basis it was found that the number known on any given day varied from 32%

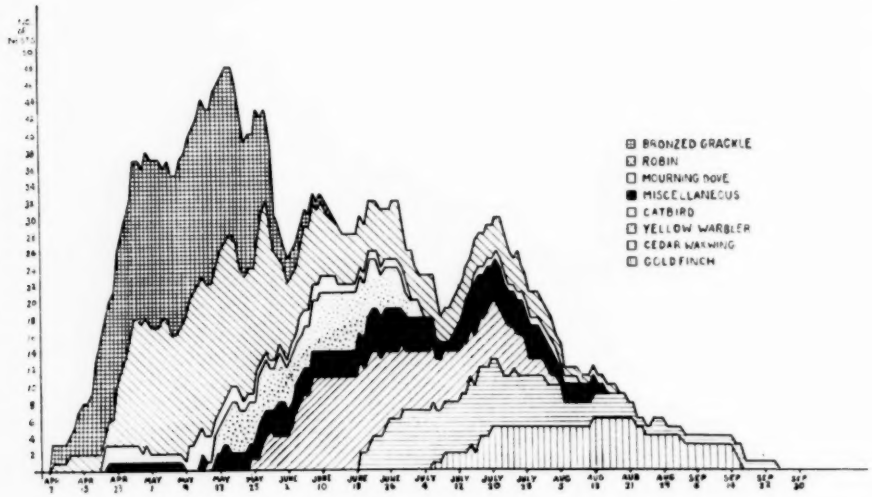

FIG. 2. Ho-Nee-Um Nests, 1947

to 100% of the number actually present. This does not take into consideration nests of Song Sparrows, since time did not permit extensive searches for them, and only 2 were found. On the peak days, May 19–20, 88% of the nests had been located. Comparison of the number of nests found with the estimated total of nests in Table 1 shows that about 87% of all nests were eventually found. In view of these facts the writer believes that Figure 2 represents a fairly accurate graph of the nesting. Errors in extrapolation would push individual peaks and depressions 1 or 2 days in either direction, but these would tend to compensate for each other, and the general picture would remain the same.

Three major peaks in nesting density are discernible in Figure 2; late May (mainly Robins and Grackles), most of June (Robin, Catbird, Yellow Warbler and Cedar Waxwing), and mid-July (Catbird, Waxwing, Goldfinch). The

meagerness of the data prevents extensive discussion, but a few interesting things may be pointed out. The overlapping nesting periods of Robins and Grackles, both using the same nesting sites (arbor vitae), makes them competitors. Cedar Waxwings also nested almost exclusively in arbor vitae, but did not start until the Grackles were gone and Robin nesting was much diminished. The Gold-

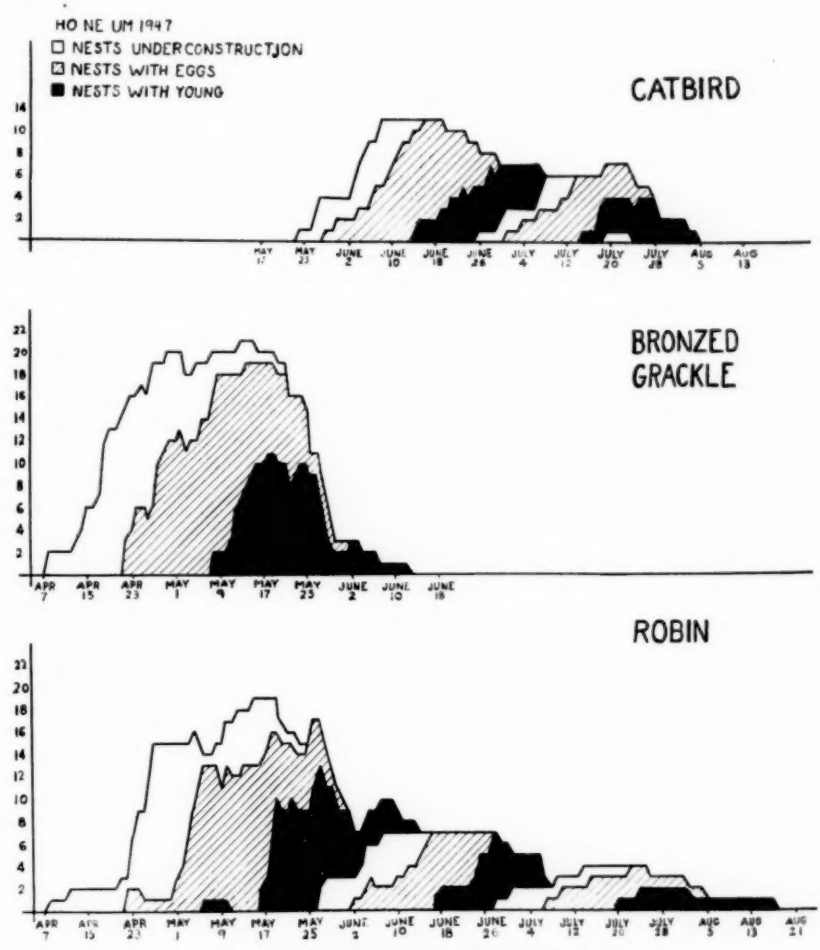

FIG. 3. Comparative Nesting Cycles, 1947

finches and Yellow Warblers nested mainly in ninebark; there was about a two week overlap in their nesting periods. It is impossible to say how much competition for nesting sites affected the density of the various species; as previously mentioned, little interspecific strife was observed.

Figure 3 compares the nesting cycles of the 3 most abundant species at Ho-

Nee-Um. It demonstrates the "Highest Nest Density" discussed before and makes possible comparisons, as between the Robins and Grackles. More Robins nested on the area than Grackles (Table 1), but their nesting was spread over a much longer period, and at no time did they attain a density as high as that of the Grackle's peak. The graph of the Grackles, which are single-brooded, lacks the long "tail" characteristic of the other species. More than half of the Grackle nests were broken up, and it would seem that the lack of a "tail" on their graph indicates that either no renesting attempt was made, or that the birds moved entirely off the area for the next attempt. Part of the sharp fall in the number of Robin nests after May can possibly be explained by the scarcity of hardwood trees on the area. Howell (1942: 549) found that 57% of the Robin nests he studied were built in conifers during the first nesting period, but later, when the

TABLE 2
Ho-Nee-Um Nesting Data, 1947

SPECIES	A Active nests	B Successful	C % Successful	D Eggs per nest	E % Hatched	F Fledglings per nest	G % Eggs producing fledglings	H % of young fledging	I Av. success of productive nests
Bronzed Grackle	26	12	45	4.5	72	4.3	44	61	84
Robin	36	18	50	3.3	61	2.4	37	61	73
Catbird	22	12	55	3.1	65	2.9	51	79	92
Cedar Waxwing	14	8	57	3.9	54	2.6	39	72	77
Yellow Warbler	12	5	42	3.5	48	2.8	33	70	74
Mourning Dove	11	2	18	1.8	30	2.0	20	66	100
Totals and averages	121	57	47	—	61	—	40	66	81

D computed from A; F computed from B.
B—Nests producing at least 1 young.

hardwood trees had leafed out, the number of Robins found nesting in conifers fell to 38%.

Nesting Success and Causes of Failure

Table 2 compares the nesting data of the various species for which at least ten nests were found. Again the small number of nests precludes intensive analysis of the figures, but some basis for comparison of nesting success is available.

Comparison of the percent of eggs hatching (E) with the percent of young fledging (H) shows a differential effect of environment on the various species under consideration. The Robins suffered losses approximately equal during the egg stage and the nestling stage. Catbirds and Grackles were affected in directly opposite fashion, the former having a heavier loss during the egg stage, the latter during the nestling stage. In the case of the Grackles, a bad storm when there were many small young in the nest accounted for much of the mortality.

The same comparison also indicates that the species having the poorest success in hatching eggs generally had a proportionately greater success in fledging their young. It is interesting to note that in comparing success from year to year, Nice's (1937: 141) figures for the Song Sparrow show the same general pattern within a single species. In her Table XVI, by dividing the number of fledglings by the number of hatched eggs, the following figures are obtained:

Year	*% of Eggs Hatching*	*% of Young Fledging*
1930	68%	63%
1931	72%	63%
1932	61%	61%
1933	51%	37%
1934	35%	78%
1935	41%	71%

The non-conformity of 1933 is apparently due to plowing of the nesting area at a time when most of the nests contained small young. Very close correlation should not be expected, since there are many other factors besides hatching success which could influence the fledgling success.

A similar situation is suggested in a study of the Eastern Red-winged Blackbird (*Agelaius phoeniceus*) by Smith (1943: 190). Of two nesting Red-wing populations, "A" hatched 74% of 563 eggs and fledged 80% of the young, "B" hatched 70% of 577 eggs and fledged 84% of the young. Much more data is needed for statistical testing, but it appears that there is possibly a compensatory interaction here following the general pattern that low egg survival results in high nestling survival, or conversely, that high nestling survival is associated with low egg survival. Errington (1946: 170) used Smith's data to illustrate the effects of predation, showing that a high loss of eggs apparently resulted in reduced vulnerability of the nestlings to predation. Another factor possibly involved is competition between nestlings, which Emlen (1942: 151) considered a major factor in nestling survival in the Western Crow.

Comparison between species of reproductive success, based on the number of young fledged per pair or per nest, will always be affected by the varying clutch size among the different species, and the varying number of broods raised. These factors can be eliminated by comparing the percent of eggs producing fledglings (Table 2–G). Considering each egg as a reproductive attempt, this shows what percent of the reproductive potential is attained. On this basis Catbirds were the most successful breeders at Ho-Nee-Um, (51% of their eggs producing fledglings) while Mourning Doves were the least successful, (only 20% of their eggs producing fledglings). The average success of productive nests (Table 2–I) was computed by dividing the number of fledglings by the number of eggs. The Mourning Dove nests were either complete failures or total successes, reflecting the birds' quickness to desert when molested. On the other hand, the Robins were able to bring off broods successfully after disturbances, though in only a few cases were their nests 100% successful.

Reproductive success possibly has the same inverse correlation with density as shown for reproductive activity by Kendeigh (1934: 308). Smith (1943: 204) found no evidence of this in the Red-wing, but Errington (1945: 14) found an inverse ratio between spring density and summer population gain of the Northern Bob-white (*Colinus virginianus*). Now that nesting studies have become more common it should be possible to compile similar data on various species from several areas. The value of these would be enhanced if it were also possible to compare the densities of the different areas, but this information is seldom available. More intensive studies might show optimum densities for

TABLE 3
Nest Success in Various Studies

SPECIES	NESTS	SUCCESSFUL %	REFERENCE	LOCATION	YEAR
Robin	501	78	Kendeigh, 1942	Ohio	?
	136	61	Howell, 1942	N. Y.	1937–38
	64	77	Koehler, 1945	Wisc.	1945
	36	50	This study	Wisc.	1947
	16	13	Thomsen, 1944	Wisc.	1944
Catbird	142	70	Kendeigh, 1942	Ohio	?
	22	55	This study	Wisc.	1947
Cedar Waxwing	29	58	Kendeigh, 1942	Ohio	?
	14	57	This study	Wisc.	1947
	12	50	Lea, 1942	Mich.	1940–41
Yellow Warbler	25	80	Kendeigh, 1942	Ohio	?
	16	75	Kendeigh, 1941	Iowa	1940
	12	42	This study	Wisc.	1947
Mourning Dove	2877	48	McClure, 1946	Iowa	1938–40
	325	47	McClure, 1946	Nebr.	1941–43
	57	54	Kendeigh, 1942	Ohio	?
	11	15	This study	Wisc.	1947
	10	70	McClure, 1946	Calif.	1944

the different species, such as has been shown for various invertebrates by Allee (1931: 161–180).

Nice (1937: 143) postulates 40% to 46% as typical success for open nests of passerines in the North Temperate Zone. At Ho-Nee-Um the passerine species averaged 49.8% successful in nesting attempts, a figure which agrees quite well with her estimate.

Table 3 compares the nesting success at Ho-Nee-Um with that of the same species in other areas. No references were found for the Bronzed Grackles, and again the species are limited to those for which at least 10 nests were found at Ho-Nee-Um. The data of Kendeigh (1942) were adjusted to make them conform to "active" nests as defined in this study. Unfortunately, information on density was not given in the other studies, but the consistently low success at

Ho-Nee-Um (excepting Cedar Waxwings) is possibly a reflection of its high nesting density. However, such a comparison suffers from the fact that the other studies sometimes covered several years, and were from many different area types. Omitting the Ho-Nee-Um data, the nest success of the passerine species listed in Table 3 averages 74%, nearly double Nice's estimate for open nesting of passerine birds.

TABLE 4
Nest Failures Ho-Nee-Um, 1947

	SPECIES							
	Bronzed Grackle	Robin	Catbird	Cedar Waxwing	Yellow Warbler	Mourning Dove	Total	Per cent
Nest failures								
A Predation	4	7	7	3	2	6	29	45
B Desertion	8	6	3	2	4	2	25	39
C Weather	2	5	0	1	1	1	10	16
D Total	14	18	10	6	7	9	64	100
Eggs not hatching								
A Predation	19	14	20	8	11	12	84	52
B Desertion	2	15	2	8	5	2	34	21
C Weather	0	6	0	0	0	0	6	4
D Unaccounted	9	4	0	2	1	0	16	9
E Infertile/addled	3	7	2	7	5	0	24	15
F Total	33	46	24	25	22	14	164	100
Young not fledging								
A Predation	0	10	7	1	0	0	18	21
B Desertion	9	3	0	1	0	0	13	15
C Weather	17	8	0	2	0	2	29	34
D Unaccounted	5	7	2	2	0	0	16	18
E Fell from nest	1	1	0	1	3	0	6	7
F Died in nest	1	0	0	1	0	0	2	2
G Cowbird parasitism	0	0	0	0	3	0	3	3
H Total	33	29	9	8	6	2	87	100

All nest failures could be attributed to one of 3 causes: predation, desertion, or storm damage. The effect of these on the species studied, referring only to "active" nests, is shown in Table 4.

Two Robin nest desertions were directly due to activities of the observer. Three Robin eggs, 1 Grackle egg, and 1 Yellow Warbler egg were accidentally broken; they were listed as lost due to predation. As far as could be determined the activities of the study had no other effect upon the species under consideration.

The predation was nearly 100% by an unknown avian form which punctured the eggs in the nest. Bronzed Grackles were suspected, but were never seen at

the nests of other species, or carrying their eggs or young. The Grackles were common on the area from late March to late June, but egg losses continued at about the same rate after their departure. If a predator took 1 egg out of a clutch and the owner deserted, the remainder of the eggs were listed as lost due to desertion. Predation on adult birds was not observed, and its extent is not known. However, it probably does introduce an error in the records on deserted nests, since some of the resident birds may have disappeared because of predation rather than because they deserted.

Predation was the chief cause of nest failure, operating most strongly during the egg stage. Weather of course would act differently on the various species from year to year, depending upon the time that bad storms happened to occur.

Summary

Nesting birds were studied in a five-acre park area with arbor vitae and bluegrass lawn as the main cover types.

A total of at least 15 species (94 pairs) bred on the area during the period of study.

May and June were the months of highest nest density. On May 19–20 there were 9.6 active nests per acre. The average number of nests per acre for the season was 4.3. The total density for the season was 32.8 nests per acre.

The high density did not produce any noticeable interspecific strife.

Catbirds were the most successful breeders, producing fledglings from 51% of their eggs; Mourning Doves were the least successful, producing fledglings from 20% of their eggs.

Those species suffering the greatest loss of eggs in the nest generally appeared to be the most successful in raising nestlings.

Predation by an unknown avian form was the main cause of nest failures.

REFERENCES

Allee, W. C.
1931 Animal aggregations. University of Chicago Press, 431 pp.
Emlen, J. T. Jr.
1942 Notes on a nesting colony of Western Crows. *Bird-Banding*, **13:** 143–154.
Errington, P. L.
1945 Some contributions of a fifteen-year local study of the Northern Bobwhite to a knowledge of population phenomena. *Ecol. Mon.*, **15:** 3–34.
1946 Predation and vertebrate populations. *Quart. Rev. Biol.*, **21:** 144–177.
Howell, J. C.
1942 Notes on the nesting habits of the American Robin. *Amer. Midl. Nat.*, **28:** 529–603.
Kendeigh, S. C.
1934 The role of environment in the life of birds. *Ecol. Mon.*, **4:** 299–417.
1941 Birds of a prairie community. *Condor* **43:** 165–174.
1942 Analysis of losses in the nesting of birds. *Journ. Wildl. Man.*, **6:** 24–42.
Koehler, A. Mrs. and G. Koehler
1945 A bird study in the Madison Cemetery. *Passenger Pigeon*, **7:** 15–19.
Lea, R. B.
1942 A study of the nesting habits of the Cedar Waxwing. *Wils. Bull.*, **54:** 226–236.

McCLURE, H. E.
1946 The Mourning Dove in Nebraska and the West. *Auk*, **63:** 24–42.
NICE, M. M.
1937 Studies in the life history of the Song Sparrow, Part I. *Trans. Linn. Soc. N. Y.* **4:** 141–143.
SMITH, H. M.
1943 Reproductive success in the Eastern Redwing (*Agelaius p. phoeniceus*) in relation to Darling's hypothesis. *Ecol.* **24:** 183–207.
STEINBACHER, G.
1942 Die Siedlungsdichte in der Parklandschaft. *Journ. für Ornith.*, **90:** 342–359.
THOMSEN, H. F.
1944 Ornithological abstracts from an ecological survey of the University Bay Region. *Passenger Pigeon*, **6:** 3–13.
YOUNG, H. F.
1947 1947 Ho-Nee-Um Robin study. Unpubl. MS., Zoology Dept., Univ. Wisc., Madison, Wisc.

ZOOLOGY DEPARTMENT, UNIV. OF WISCONSIN, MADISON, WISCONSIN.

THE WILSON BULLETIN PUBLICATION DATES

The actual dates of publication of the four numbers in 1948 were: March 22, June 22, October 13, December 28.

GENERAL NOTES

BREWSTER'S WARBLER BREEDING IN YATES COUNTY, NEW YORK

Potter Swamp, in west-central New York, occupies a long narrow, roughly north-south valley between Canandaigua and Cayuga Lakes. In effect, it represents an extinct member of the Finger Lakes group. Much of the best habitat for the more truly marsh-loving birds is being destroyed at the present time by extensive drainage operations. However, the area continues to support a rich population of nesting birds, the proportion of species encountered changing gradually, as in other drained areas, with the change in environment.

On June 22 and 23, 1948, Stephen W. Eaton and I were collecting in the higher portion of the Potter Swamp area. On the afternoon of June 22, I collected a female Brewster's Warbler (*Vermivora "leucobronchialis"*) and her mate, a typical male Golden-winged Warbler (*V. chrysoptera*). The call-notes of the two birds were identical; the male was not singing. The female bird conforms well with Ridgway's description (U.S.N.M. Bull. 50, part II, 1902; p. 454). Since a well-developed brood-patch was present, Eaton returned the next morning to the spot at which the adult birds had been collected, and succeeded in finding their five young. These birds had apparently just left the nest, and Dr. Arthur A. Allen estimated their age at about ten days.

Assuming that the Brewster's Warbler parent was an F_1 hybrid between *V. chrysoptera* and *V. pinus*, and that the male parent was a homozygous Golden-winged Warbler, the expected Mendelian ratio in the offspring would be 50% Brewster's and 50% Golden-winged Warblers. While it is, of course, impossible to state into which plumage each of our five juvenal birds would have molted, there is a definite color difference. Three of these young birds (two females and one male) have much grayer underparts than do the other two (one female and one male). The three grayish birds are quite uniform as are the two yellowish ones.

Through the courtesy of the American Museum of Natural History, I have been able to compare our specimens with five juvenal *V. pinus* and one *V. chrysoptera* of the same age as our specimens. None of our specimens is like any of these. The one *V. chrysoptera* examined is much darker, both above and below, than any of our specimens. Our two yellowish birds approach the lightest examples of *V. pinus*, but are substantially less intensely colored. Our three grayish birds are much paler and grayer than any of the *V. pinus* or *V. chrysoptera*. It might be of interest to record the colors of these five specimens. There is little, if any, difference in the color of the upper parts among the five. All have the back approximately Citrine Drab (color names from Ridgway, Color Standards and Color Nomenclature, 1912), brightening to Yellowish Citrine on the crown. The wing-bars of all five are Citron Yellow. The three grayer birds have Grayish Olive breasts, shading to Deep Olive Buff on the belly. The two yellower specimens, on the other hand, have the breasts Light Yellowish Olive, shading to Amber Yellow on the belly.

Both the Blue-winged and Golden-winged Warblers have been increasing in New York during the past two decades. The Golden-wing, the commoner of the two over most of the state, is appearing for the first time as a breeding species in southwestern New York, and is spreading out on the periphery of its formerly rather discontinuous range in the central portion of the state. The Blue-winged Warbler must be considered rare throughout most of New York except for the lower Hudson Valley region, Long Island, and the Buffalo region. It has been recorded sporadically over much of central and western New York. Until 1946 there was but one sight record of this species in the Cayuga Lake basin; there have been three since. It would seem logical for an occasional Brewster's Warbler to appear in central New

York, since a stray Blue-wing which lingered on into the breeding season would not be likely to find a mate of its own species, but plenty of available Golden-wings.

In spite of this probability, the Brewster's Warbler has apparently never before been collected in New York away from the southeastern corner. A search through the files of *The Prothonotary* reveals a number of sight records for the Buffalo area, including two nesting records near Versailles. This is not unexpected, as both of the parent species breed in this vicinity. Other than in this western New York area, and in the Hudson valley—Long Island region, there are but a few sight records for Brewster's Warbler; at Rochester, Canandaigua and Corning. None is a breeding record, and no specimen was taken. Our Potter Swamp specimens, therefore, represent the first breeding record of Brewster's Warbler, authenticated by specimens, in New York outside of the southeasternmost counties.

The skins of the two parents and their five offspring have been deposited in the Louis Agassiz Fuertes Memorial Collection at Cornell University. I am indebted to Edgar M. Reilly, Jr., who checked for me the distribution files of the U. S. Fish and Wildlife Service.—Kenneth C. Parkes, Laboratory of Ornithology, Cornell University, Ithaca, N. Y.

RUFFED GROUSE EATS SNAKE

In the Porcupine Mountains, Ontonagon County, Michigan on September 16, 1947, I flushed two Ruffed Grouse (*Bonasa umbellus*) from the ground into tall hemlocks. One shortly fell fluttering to the ground. The second bird then flew down and joined it. On my closer approach, both birds again flushed. A medium-sized snake, probably 1.5–2 feet long, dangled limply from the mouth of one bird. It appeared that the snake had been partly swallowed, but about a foot of its length was left protruding from the bird's beak. The grouse seemed abnormally weak but its peculiar flight and fall may have been due to awkwardness caused by its unusual prey.

The birds could not be located again and the snake was unidentified. Scott (Auk 64: 140, 1947) has recorded finding a small Red-bellied Snake (*Storeria occipitomaculata*) in the crop of a Ruffed Grouse in Wisconsin, but this must be a very unusual food item nevertheless.—George A. Petrides, Ohio Cooperative Wildlife Research Unit, Ohio State University, Columbus 10, Ohio.

CONSERVATION

Waterfowl inventory. The field investigations conducted by the various agencies working with waterfowl have been greatly expanded during the past year, giving promise for a healthier program for ducks. When it was realized, early in 1946, that waterfowl populations had severely declined, naturalists were disturbed by the confusion which prevailed. The setback followed the greatest wildlife management program in history, and evidences of the decline came while managers were most optimistic regarding the security of waterfowl. For more than a year the matter was thrown back and forth between groups which held, on the one hand, that the situation was a matter of small concern, and others which saw further and more serious troubles ahead if drastic measures were not taken to check the kill. This controversy received nationwide attention in the press, with neither side of the question supported by conclusive facts.

Fortunately, one first step taken to meet the situation was an expansion of the field investigations for the appraisal of waterfowl numbers. In 1946 the U. S. Fish and Wildlife Service sent 5 men and 2 aircraft to the Prairie Provinces of Canada, where their appraisals previously had been accomplished by 1 to 3 men in cars. Last year this Service crew numbered 7 men and 3 planes, while the leader of this party, Robert H. Smith, traveled on to the Arctic Coast where he spent a month running air transects over breeding areas between Point Barrow, Alaska and Bathurst Inlet, Northwest Territories. This appriasal work began when the breeding ducks settled on the prairies in late April and continued through August.

These Service biologists have developed for recording the resident breeding populations an objective method which is proving far more accurate than the previous examinations of the summering aggregations. In this spring work they are dealing with a relatively stable population, and one which, area by area, is small enough to be counted. Transects run by car, canoe or from aircraft give a highly accurate figure which can be compared year by year. Two Stinson L-5 aircraft—flying jeeps used during the war—cover the prairie marshes, while the Grumman Widgeon, an amphibian, is used in the Arctic. The spring survey, completed by July 1, provides part of the information upon which the autumn shooting regulations are set. During the remainder of the season the field crews study population shifts, rearing success and water conditions. An intensive breeding-ground banding program was carried out during July and August.

This Fish and Wildlife Service work is but one part of a highly cooperative venture. In Canada, the Dominion Wildlife Service and the Provincial governments have stepped up their own waterfowl programs, and the Service biologists work with these agencies. Moreover, the breeding grounds of the northern States, generally underrated as duck producers, have been carefully covered by a joint project between the State agencies and the Service. The Delta Waterfowl Research Station has been headquarters for the eastern prairie teams which have worked out many of their techniques there. Thus, there is developing a comprehensive picture of waterfowl production, and policy is now being guided by facts to an extent never before possible. The force of this new information has dispelled the controversy and is doing much to win the sympathy and interest of sportsmen, a matter of no small importance in drawing up a workable plan for waterfowl. The 1948 breeding ground inventory gave evidence of improved conditions and permitted anticipation of increased flights in most sections of the United States this fall.

For 10 years the Fish and Wildlife Service has released an annual figure representing their estimate of total waterfowl numbers. This, in recent years, was matched by other population estimates advertised by sportsman's groups, these sometimes being in wide contrast to the Service figures. The various agencies have agreed that total population figures lead to con-

fusion in the minds of many sportsmen, and, therefore, that only estimates of increase or decrease should be released. The annual figure, however, is of great importance in guiding policy, particularly in respect to species with numbers so small as to be endangered by any misunderstandings regarding the size of the population to be harvested. Consequently, the January inventory, like the summer appraisals, is receiving more attention, and has been improved by new techniques and more air observations which now reach deep into Mexico and Central America to cover the wintering aggregations there.

The possibilities of international cooperation for investigation of waterfowl were emphasized by Peter Scott, British naturalist and bird artist, who returned to England after a month in the United States and Canada where he visited many waterfowl refuges and marshes. He is now Director of The Severn Wildfowl Trust, established at Slimbridge, Gloucestershire in 1946, where studies of British waterfowl are being undertaken. Despite the vast differences between British and American wildfowling methods, Scott believes that conservation on both sides of the ocean would be advanced by closer associations between British and American biologists working with waterfowl. The 1948 report of the Severn station is now available, at the price of $1.00. Its 72 pages give details of the Station's program, a description of some decoys and a discussion of a trapping technique in which rockets are used to throw a net over feeding geese. There is also an excellent color plate of one of Scott's recent paintings.

ALBERT HOCHBAUM, Conservation Committee

LITERATURE

Comments on Recent Literature

Subspeciation in Song Sparrows. Similar species having more or less dissimilar ecological requirements frequently occur together, suggesting that they evolved side by side through a process of ecological divergence. Yet with rare exceptions, incipient species (subspecies) of a given species are not found together during the breeding season. Indeed, no very plausible genetic theory as to how a freely interbreeding, localized population could break up into races, and eventually species, has been advanced. In a review of this problem Mayr (1947) concluded that although all subspecies probably differ to some extent ecologically, geographical isolation is necessary for their evolution. Once reproductive isolation is achieved, similar species may acquire overlapping ranges. Competition between them then becomes a potent factor in promoting further ecological divergence.

Many birds once believed to be examples of ecological speciation, such as various Galapagos finches, are now thought to have passed through the usual initial stage of spatial isolation. Another group that suggests the control of speciation by ecological factors, possibly without geographic isolation, is the series of races of the Song Sparrow, *Passerella* (*Melospiza*) *melodia*, found near San Francisco Bay, some in salt or brackish marches, others in the uplands. Thus Huxley (1942: 272) referred to them as "a case of ecotopic subspeciation in birds where the two forms are kept separate by their ecological preferences." A much needed, thorough study of these birds has now been accomplished by Marshall (1948). He personally collected more than 800 specimens during the course of his intensive field studies. These and many others were compared and measured and the stomach contents, along with other ecologically significant data, recorded.

Four races of Song Sparrows are involved. Three, *samuelis*, *pusillula*, and *maxillaris*, are found, respectively in large salt or brackish marshes north, south, and east of the Bay. The fourth, *gouldii*, is found in adjacent suitable habitats around the Bay and merges with other mainland races to the north and south. " . . . The dense bay marsh populations are separated from each other by open water or by ranges of hills jutting into the bay and are separated from upland populations by the width of the arid bayside plain" (Marshall, p. 208). Narrow connecting avenues of Song Sparrow habitat do exist between the ranges of these subspecies where, with one exception mentioned below, complete interbreeding and intergradation occur in the bird populations.

These groups of Song Sparrows thus do not differ from ordinary geographic subspecies as respects isolation but their ranges are unusually small for conti-

nental subspecies. The sedentary habits of this abundant, resident species apparently provide sufficient isolation for this subspeciation. Even in Ohio, where many of the Song Sparrows migrate, the banding records of Mrs. Nice as interpreted by Miller (1947) indicate that most Song Sparrows settle within 300 yards of their birthplace.

The second unusual feature of these races of the Song Sparrow is the ecological diversity of the areas they inhabit. Miller (1942) had already suggested that the large number of subspecies found in the Song Sparrow as compared with, for example, the congeneric Lincoln's Sparrow, *P. lincolni*, is a result of the greater ecological tolerance of the former. The Song Sparrow is able to colonize diverse habitats; its sedentary habits then permit the evolution of races adapted to them. The habitats occupied by the Song Sparrow all possess certain characteristics vital to this species such as available water, plenty of light, plenty of vegetation within certain limits as to density, and area suitable for ground foraging. Wherever these conditions are met the Song Sparrow is at home. Thus where small areas of salt marsh are surrounded by upland habitat, the population is continuous and no racial variation is found. Along the marsh edges individual birds may feed daily on the seeds of both marsh and upland plants.

Although the individual Song Sparrow, if transplanted, would as a rule be "at home" in any of these habitats, nevertheless the racial characters of the salt marsh subspecies are presumably adaptive responses to local conditions. Where two races meet and intergrade neither is swamped out in its own habitat. Intergradation is most pronounced in the zone where the habitats themselves are intergrading. Natural selection apparently preserves the racial characters.

These rather isolated subspecies may be expected to have non-adaptive as well as adaptive genetic differences. Miller (1947) has pointed out that even in continuous populations of such a sedentary species local fixation of neutral genetic characters might occur by chance in accordance with the so-called "Sewall Wright effect." This would happen even more readily in small, isolated populations. Marshall, however, with one exception, finds the characters of the smaller or intermediate populations to vary in a gradual, predictable manner that suggests adaptive clines. His final conclusion is: "To my mind, the pronounced geographic variation shown in local Song Sparrows is but another example of this nicety of adjustment of the species to its local environments; nowhere do we find a suggestion of the gross differences in habitat preference or the qualitative differences in foraging, song and mating behavior, nor the overlap in distributions which differentiate Song Sparrows from Lincoln Sparrows and Fox Sparrows, the congeners of *Passerella melodia*" (p. 254).

It is, of course, unlikely that these Bay races of Song Sparrow will persist long enough and in sufficient isolation to become distinct species. Yet I believe that Marshall's attempt sharply to contrast their racial characters with species characters is contrary to what must normally occur in speciation and may be

occurring here. The latter suggestion is prompted by Marshall's analysis of the birds of a habitat, since destroyed, on San Francisquito Creek where the upland-willow and salt marsh habitats (and subspecies) met sharply without the usual slow transition. A series of Song Sparrows collected there about the turn of the century by Grinnell shows little hybridization, much less than would be expected if the 2 subspecies had interbred as freely as their proximity permitted. Grinnell (1901), who, incidentally, first realized the importance of these Song Sparrows as material for the study of evolution, concluded, I believe correctly, that at this point the 2 subspecies were behaving like incipient species. In races possessing adaptive modifications to rather different habitats and incipient (at least) preference for these habitats, sufficient time and isolation might well lead to speciation and the eventual acquisition of characters and behavior patterns as "qualitatively" distinct as those of such species as the Swamp Sparrow or the Seaside Sparrow.

GRINNELL, JOSEPH

1901 The Santa Cruz song sparrow, with notes on the salt marsh song sparrow. *Condor*, **3:** 92–93.

HUXLEY, JULIAN

1942 Evolution, the modern synthesis. Harper: London and New York.

MARSHALL, JOE T., JR.

1948 Ecologic races of song sparrows in the San Francisco Bay region. *Condor*, **50:** 193–215; 233–256.

MAYR, ERNST

1947 Ecological factors in speciation. *Evolution*, **1:** 263–288.

MILLER, ALDEN H.

1942 Habitat selection among higher vertebrates and its relation to intraspecific variation. *Amer. Nat.*, **76:** 25–35.

1947 Panmixia and population size with reference to birds. *Evolution*, **1:** 186–190.

DEAN AMADON

These comments are intended to review recent and somewhat unavailable papers covering several aspects of ornithology during the year. Your editor will appreciate remarks from Club members concerning this method of literature review.

EDITOR

BOOK REVIEWS

Birds Over America. By ROGER TORY PETERSON. Dodd, Mead and Company, New York, 1948: 7 x 10 in., XVI + 342 pp., 80 plates and one end-paper photograph. $6.00.

Better than any other book I know, this one conveys the spirit of the enthusiast in the sport of bird study. Its pages are filled with the "shop talk" of the field ornithologist—query, speculation, anecdote of the kind we hear wherever members of the clan gather: Where is

the Bachman's Warbler? How many birds are there in America? Which bird is the most common? What are the prospects for survival of the Ivory-billed Woodpecker? Why is the Peregrine the favorite bird of so many people? What happens to birds in a hurricane? Where are the best places to see birds? What are the attractions (ornithological) of Maine, Cape May, Santee delta, Everglades, Dry Tortugas, Louisiana swamp, Texas coastal plain, Arizona desert, California waters, Utah marshes?

These and scores of other questions receive thoughtful comment in the twenty-five chapters of this book. Through them we gain a new appreciation of the years of vigorous field work, the keen eye, and the precise mind which made possible the famous "Field Guides."

Outsiders may view somewhat quizzically such single-minded preoccupation with avian affairs. Some readers may be disappointed that they do not see more of Peterson's own personality in this book, or that they do not become better acquainted with the other men who appear briefly in it. Probably few will read it as literature, although it has many eloquent passages. And we may all wish that a more colorful and distinctive title had been chosen. But, in total, this work will need no defense before those thousands of people who share Peterson's own enthusiasm for the living bird.

It will be a surprise to most of Peterson's readers to find that this fine artist is such a skilled photographer. The proof is provided in 107 splendid pictures selected from among thousands in his collection. Everyone will have his own favorite, but the three views of the young bald eagle I consider as dramatic as any bird pictures I have seen. Thoughtfully, Peterson has appended a two-page "Photographic Postscript," offering information about his methods and equipment.

An index has been provided, and it is particularly helpful in a book of this kind which touches upon such a diversity of subjects in such an informal manner.

HAROLD MAYFIELD

British Birds. By WILFRED WILLETT. Illustrated by 16 color plates and 44 drawings by Roland Green. A. and C. Black, London, 1948: 9 x 6 in., vii + 196 pp. $2.50 (Macmillan).

This book is written to introduce the adult beginner to 200 of the commonest birds of the British Isles. The introduction gives elementary hints about bird study, such as where and when to look for birds, and what characters are important in field identification; no scientific names appear in the book. Each of the 27 chapters discusses a group of closely related or associated species, giving pointers for identification and prominent aspects of life history of each. Chapter headings list the names, total lengths, and usual habitats of both land and water birds. The style is simple and straightforward, and considerable information is presented. The color plates are fair, and certainly useful; the black and white drawings less so. Six scattered pages of the review copy were inadvertently left blank. While this volume will be useful to Britishers who wish to learn something about their common birds, most Americans who are sufficiently interested to undertake a study of British birds will want a more advanced book.

HUSTACE H. POOR

Flight Into Sunshine, Bird Experiences in Florida. By HELEN G. CRUICKSHANK. Photographs by Allan D. Cruickshank. The Macmillan Company, New York: 1948. 132 text pages, 121 photographs in black and white.

The vogue for naturalists' wives to write of their husbands' activities continues to gain momentum. While the composition of such biographies may be an excellent means for keeping the wives occupied and contented, one wonders what the reason can be for this sudden wealth of second hand books. The answer is probably to be found in the curious

fact that the public will buy almost any nature book, and the publishers will therefore accept almost any nature manuscript. After some pioneer discovered that here was a convenient way to make a few dollars, the deluge was on.

The reviewer's complaint is not so much about these books themselves as about other books that appear to be suppressed by them. The husbands, feeling themselves relieved of the responsibilities of authorship, joyfully pursue their calling with scarcely a thought of pencil or pen. Gone are the compelling accounts of nature experiences that sprang from the perceptions and reflections of the naturalists themselves. Yet who can more vividly describe a wildlife phenomenon than the chief observer? Who would dare to compare these current books with the field accounts left to us by Audubon, Townsend, Hudson, Coues, Chapman, Stone or any other of our lately extinct giants?

The foregoing comments are not aimed in particular at "Flight into Sunshine" by Mrs. Cruickshank. In fact the author is to be commended, within the category of books being considered, for her attempts at lucidity and brevity—if not at self-effacement. However the book shares with its fellows a general shallowness that is born of its very essence as the virtual image of another's work. It is reasonably well written, and the subject matter automatically makes it interesting. Due emphasis is placed repeatedly on the subject of conservation; the rôle played by the National Audubon Society in protecting wildlife is high-lighted in satisfying degree.

Twelve chapters conduct the reader from one Florida rookery to another, most of them in the Okeechobee-Everglades region. Pelicans; various herons and egrets; vultures; Florida cranes; wood, glossy and white ibises; and anhingas all obligingly allow themselves to be photographed.

The illustrations at the back of the book are a superb collection of bird photographs. Possibly the most remarkable, Figure 20, shows a brown pelican in flight with its pouch distended. One wishes that a more expensive paper had been used for the reproductions, so that a hard glossy finish could have been obtained. Much fine detail is lost in the present form of the illustrations.

"Flight into Sunshine" will undoubtedly enjoy popularity in the segment of our population that reads nature books. Without question its success will spur the creation of more books of the same sort.

C. Brooke Worth

Bibliography

Physiology (*including weights*)

Haverschmidt, Fr. Bird Weights from Surinam. *Wils. Bul.* **60** (4), Dec. 1948: 230–239.

Anatomy (*including plumage and molt*)

Brooks, Allan. Juvenal Saw-whet Owl. *Condor* **50** (6), Nov.–Dec. 1948: col. frontispiece, with note, p. 276.

Brooks, Allan. Arizona Woodpecker, *Dendrocopos arizonae*. *Condor* **50** (6), Nov.–Dec. 1948: 270. (Sketch, reproduced in black and white.)

Stresemann, Vesta. Eclipse Plumage and Nuptial Plumage in the Old Squaw, or Long-tailed Duck (*Clangula hyemalis*). *Avicultural Mag.* **54** (6), Nov.–Dec. 1948: 188–194.

See also *Life History and Behavior:* Delacour.

Distribution and Taxonomy

Bond, James. Origin of the Bird Fauna of the West Indies. *Wils. Bull.* **60** (4), Dec. 1948: 207–229, map.

Glandon, Mr. and Mrs. Earl W. Birds of the Stapleton Area of Nebraska. *Nebr. Bird Rev.* **16** (1), Jan.–June 1948: 1–21.

Leopold, A. Starker. The Wild Turkeys of Mexico. *Trans. 13th N. Amer. Wildl. Conf.* 1948: 393–401, map.

Mayr, E. Climatic Races in Plants and Animals. *Evolution* **2** (4), Dec. 1948: 375–376.

Mengel, Robert M. Some Records of Importance to Kentucky Ornithology. *Kentucky Warbler* **24** (4), Oct. 1948: 49–54.

Pitelka, Frank A. The Problematical Relationships of the Asiatic Shorebird *Limnodromus semipalmatus*. *Condor* **50** (6), Nov.–Dec. 1948: 259–269, figs. 54–55.

Rand, A. L. Birds of Southern Alberta. *Natl. Mus. Can. Bull. No.* **111** (*Biol. Ser. No.* **37**), 1948: 1–105, 2 pls., map.

Sutton, George Miksch. Comments on *Icterus cucullatus cucullatus* Swainson in the United States. *Condor* **50** (6), Nov.–Dec. 1948: 257–258.

Talmadge, Robert R. The Cowbird Moves Northward in California. *Condor* **50** (6), Nov.–Dec. 1948: 273–274.

Van Tyne, Josselyn. Eskimo Curlew and Whimbrel collected in Newfoundland Labrador. *Wils. Bull.* **60** (4), Dec. 1948: 241.

Youngworth, Wm. Observations on Some Eastern Montana Birds. *Nebr. Bird. Rev.* **16** (1), Jan.–June 1948: 38–50.

See also *Migration and Flight:* Neff. *Ecology:* Marshall. *Food and Feeding Habits:* Wallace.

Evolution and Speciation

Rand, A. L. Glaciation, an Isolating Factor in Speciation. *Evolution* **2** (4), Dec. 1948: 314–321, 5 figs.

Wright, Sewall. On the Roles of Directed and Random Changes in Gene Frequency in the Genetics of Populations. *Evolution* **2** (4), Dec. 1948: 279–294, 7 figs.

Zangerl, Rainer. The Methods of Comparative Anatomy and its Contribution to the Study of Evolution. *Evolution* **2** (4), Dec. 1948: 351–374, 8 figs.

See also *Distribution and Taxonomy:* Bond; Mayr.

Migration and Flight

Neff, Johnson A. Russian-banded Emperor Goose Killed in California. *Condor* **50** (6), Nov.–Dec. 1948: 271.

Ecology

Marshall, Joe T., Jr. Ecologic Races of Song Sparrows in the San Francisco Bay Region. Part II. Geographic Variation. *Condor* **50** (6), Nov.–Dec. 1948: 233–256, figs. 48–53.

See also *Population:* Wright.

Life History and Behavior

Allen, Arthur A. The Curlew's Secret. *Natl. Geogr. Mag.* **94** (6), Dec. 1948: 751–770, 8 col. plates, 2 maps, 5 photos. (Nests and eggs of *Numenius tahitiensis*).

Baker, Maurice F. Notes on care and development of young Chimney Swifts. *Wils. Bull.* **60** (4), Dec. 1948: 241–242.

Brackbill, Hervey. An unusual song of the Slate-colored Junco. *Wils. Bull.* **60** (4), Dec. 1948: 246.

Broekhuysen, G. J. Observations on the Great Shearwater in the Breeding-Season. *Brit. Birds* **41** (11), Nov. 1948: 338–341, pls. 55–59. (*Puffinus gravis*).

Campbell, Louis W. Nest-building adaptability of the Eastern Red-wing. *Wils. Bull.* **60** (4), Dec. 1948: 244.

Childs, Henry E. Jr. Songs of the Brown Towhee Evoked by Nest Robbing by Scrub Jays. *Condor* **50** (6), Nov.–Dec. 1948: 273.

Collister, Mrs. Carl N. Nesting of the Double-crested Cormorant in Nebraska. *Nebr. Bird Rev.* **16** (1), Jan.–June 1948: 22–26, 2 photos.

Cruickshank, Allan D. Snowy Egret (*Leucophoyx thula*). *Wils. Bull.* **60** (4), Dec. 1948: pl. 6, opp. p. 207. (Photographed in Texas.)

Cruickshank, Allan D. Verdin (*Auriparus flaviceps*). *Wils. Bull.* **60** (4), Dec. 1948: pl. 7, opp. p. 246. (Photographed in Texas.)

Delacour, J. The Swans. *Avicultural Mag.* **54** (6), Nov.–Dec. 1948: 180–185.

Hall, Edward M. Black Swift Nesting in Southern California. *Condor* **50** (6), Nov.–Dec. 1948: 274.

Halle, Louis J. Jr. The Calandria Mockingbird flashing its wings. *Wils. Bull.* **60** (4), Dec. 1948: 243.

Laskey, Amelia R. Bronzed Grackle anointing plumage with orange-skin. *Wils. Bull.* **60** (4), Dec. 1948: 244–245.

Manville, Richard H. The Huron Island Rookery. *Jack-Pine Warbler* **26** (4), Oct. 1948: 152–155, 3 photos. (*Larus argentatus* and *Phalacrocorax auritus* in Marquette County, Michigan.)

Nice, Margaret Morse. Song Sparrows at Wintergreen Lake. *Jack-Pine Warbler* **26** (4), Oct. 1948: 143–151, photo. (Michigan)

Nickell, Walter P. Alternate care of two nests by a Ruby-throated Hummingbird. *Wils. Bull.* **60** (4), Dec. 1948: 242–243.

Ripley, Dillon. Waterfowl Notes from the Eastern United States. *Avicultural Mag.* **54** (6), Nov.–Dec. 1948: 194–195.

Sutton, George Miksch. Probable Breeding of the Ruby-crowned Kinglet in the Lower Peninsula of Michigan. *Jack-Pine Warbler* **26** (4), Oct. 1948: 159–160.

Tinkham, Ernest R. Notes on Actions of the Audubon Caracara. *Condor* **50** (6), Nov.–Dec. 1948: 274.

Walkinshaw, Lawrence H. Brown Creepers Nesting in Calhoun County, Michigan. *Jack-Pine Warbler* **26** (4), Oct. 1948: 157–158, pl. 10, photo.

See also *Distribution and Taxonomy:* Leopold. *Food and Feeding Habits:* Wallace. *Population:* Kinghorn and Neff.

Food and Feeding Habits

Wallace, George J. The Barn Owl in Michigan. *Mich. State Coll. Agric. Exper. Sta. Sec Zool. Tech. Bull.* **208,** Aug. 1948: 1–61, 2 figs.

POPULATION (*including age and mortality rates*)

HEIT, WILLIAM S. Texas Coastal Waterfowl Concentration Areas and Their 1947–48 Wintering Population. *Trans. 13th N. Amer. Wildl. Conf.* 1948: 323–338, map.

KINGHORN, ROBERT G., AND JOHNSON A. NEFF. Status of the Band-tailed Pigeon in Colorado, Season of 1947. Colo. Dept. Game & Fish, Denver, 1948, 13 pp. (multigraphed).

SIIVONEN, LAURI. Quantitative bird survey and the short-term fluctuations in numbers. *Ornis Fenn.* **25** (3), 1948: 37–56.

TICEHURST, N. F., AND P. H. T. HARTLEY. Report on the Effect of the Severe Winter of 1946–1947 on Bird-Life. *Brit. Birds* **41** (11), Nov. 1948: 322–334.

VOGT, WILLIAM. North American Animals Threatened with Extinction. *Trans. 13th N. Amer. Wildl. Conf.* 1948: 106–112.

WRIGHT, BRUCE S. Waterfowl Investigations in Eastern Canada, Newfoundland and Labrador, 1945–1947. *Trans. 13th N. Amer. Wildl. Conf.* 1948: 356–365.

TECHNIQUES (*including banding*)

CONGREVE, W. M. On Preparation and Data. Part 1. *Ool. Rec.* **22** (4), Dec. 1948: 49–55. (Oological techniques)

PALEONTOLOGY

WETMORE, ALEXANDER. A Pleistocene record for *Mergus merganser* in Illinois. *Wils. Bull.* **60** (4), Dec. 1948: 240.

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